PUBLISHED MONTHLY

$10.00 A YEAR SINGLE COPIES $1.00

WOOD'S MEDICAL AND SURGICAL MONOGRAPHS

CONTENTS

ON THE PREVENTIVE TREATMENT OF CALCULOUS DISEASE AND THE USE OF SOLVENT REMEDIES

BY SIR HENRY THOMPSON, F.R.C.S., M.B.

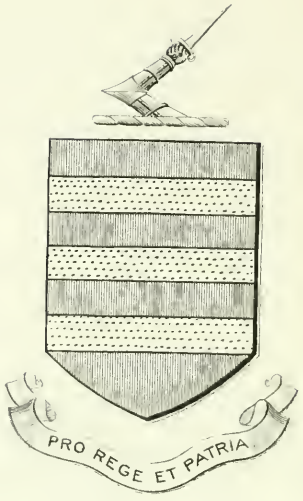
SPRAINS: THEIR CONSEQUENCES AND TREATMENT

BY C. W. MANSELL MOULLIN, M.A., M.D.

WILLIAM WOOD AND COMPANY PUBLISHERS
56 & 58 LAFAYETTE PLACE NEW YORK

VOLUME 2 NUMBER 2

MAY 1889



Bequeathed to the Library of the
University of Toronto by
Irving Heward Cameron, Esq., M.B.
Sometime Professor of Surgery
in the Faculty of Medicine

Med.
W

VOLUME II. NUMBER 2.

WOOD'S

Medical and Surgical

MONOGRAPHS

Consisting of Original Treatises and of Complete Reproductions, in English, of Books and Monographs selected from the latest literature of foreign countries, with all illustrations, etc.

CONTENTS

ON THE PREVENTIVE TREATMENT OF CALCULOUS DISEASE AND THE USE OF SOLVENT REMEDIES,
BY SIR HENRY THOMPSON, F.R.C.S., M.B. LOND.

SPRAINS; THEIR CONSEQUENCES AND TREATMENT,
BY C. W. MANSELL MOULLIN, M.A., M.D. OXON.

PUBLISHED MONTHLY

PRICE, $10.00 A YEAR SINGLE COPIES, $1.00

MAY, 1889

LIBRARY
MAR 1 1934
UNIVERSITY OF

NEW YORK
WILLIAM WOOD AND COMPANY
56 AND 58 LAFAYETTE PLACE

297921 34
3
14

Entered at the Post Office at New York, as second-class matter.
Copyright by Wm. Wood & Co. 1889.

PRESS OF
THE PUBLISHERS' PRINTING COMPANY
157–159 WILLIAM STREET,
NEW YORK.

CONTENTS.

ON THE PREVENTIVE TREATMENT OF CALCULOUS DISEASE.

LECTURE I.

PAGE

Early History of Calculous Disease and the Treatment best adapted for its Prevention 307

LECTURE II.

The Dietetic Treatment of Patients excreting Uric Acid in Excess 327

LECTURE III.

On the Treatment of Stone in the Bladder by Solvents: Its History and Practice 337

SPRAINS AND THEIR CONSEQUENCES.

INTRODUCTION.

General Considerations 355

CHAPTER I.

The Anatomy of Joints 359

CHAPTER II.

Cause and Prevention of Sprains 368

CHAPTER III.

Diagnosis 380

CHAPTER IV.

Nature of the Injury 390

PAGE

CHAPTER V.

Inflammation and the Process of Repair 410

CHAPTER VI.

Imperfect Recovery 421

CHAPTER VII.

Treatment. Cold. Heat. Pressure 432

CHAPTER VIII.

Treatment. Rest. 447

CHAPTER IX.

Forcible Manipulation 458

CHAPTER X.

Massage 470

CHAPTER XI.

Sprains of Tendons 483

CHAPTER XII.

Sprains of the Back and Neck 502

CHAPTER XIII.

Internal Derangement of the Knee 522

CHAPTER XIV.

Contraction of the Fingers. 529

CHAPTER XV.

Muscular Contraction 537

CHAPTER XVI.

Muscular Wasting 551

ON

THE PREVENTIVE TREATMENT

OF

CALCULOUS DISEASE

AND

The Use of Solvent Remedies.

BY

SIR HENRY THOMPSON, F.R.C.S., M.B. Lond.

Surgeon Extraordinary to His Majesty the King of the Belgians; Consulting Surgeon and Emeritus Professor of Clinical Surgery to University College Hospital; Fellow of University College: Late Professor of Surgery and Pathology to the Royal College of Surgeons; Honorary Member of the Société de Chirurgie of Paris; etc.

ON THE

PREVENTIVE TREATMENT OF CALCULOUS DISEASE.

LECTURE I.

EARLY HISTORY OF CALCULOUS DISEASE, AND THE TREATMENT BEST ADAPTED FOR ITS PREVENTION.

Gentlemen: We have had opportunities recently of studying together, and of examining very fully, the various operative proceedings which are generally practiced for the removal of stone from the bladder; and you have had the opportunity of seeing them performed many times, not fewer than eleven cases having passed through my wards during the last three weeks, and that each has been brought to a successful conclusion.

But, satisfactory as such a result is, it is impossible not to feel convinced that there is still an important question in relation to the treatment of this complaint which has not yet been adequately answered. And it raises an issue not less weighty, nor less intimately affecting the patients' welfare than any one of the subjects we have hitherto discussed.

The question I propose for solution is this:

Is there not a period in the history of the process which leads to the formation of renal or vesical calculus, whether in the condition of gravel, concretion, or stone, at which it might be possible to prevent the development of a considerable deposit and the necessity for mechanically removing it?

Admirable as it must be admitted are the results of modern

operative procedure, whether by the lithotrite or by the scalpel, and great as is the triumph which surgery has achieved in the art of removing stone from the bladder, I take it there are very few men who would not desire to avoid, if any means of doing so were available, the opportunity of personally illustrating these glorious successes of our craft. There is not one among us, indeed, who would not infinitely prefer to be furnished with the means of controlling or preventing the formation of calculus, on the first appearance of evidence that such a contingency is imminent or likely to occur.

I reply to the question before us, by a distinct assurance that we have the power to check the production of calculous matter at almost any stage of the complaint, and almost certainly to render it impossible, if proper treatment be adopted.

Before, however, entering on the details of the plan by which this result may be effected, I must first remark that there are, as you know, several varieties of calculus, and you may naturally ask, are all these equally amenable to treatment? For our purpose now, it suffices to regard all calculi as generally divided into two classes: those which have a local, and those which have a constitutional origin. By "local," I mean formed by diseased action in the bladder itself, and not depending upon any constitutional conditions or tendencies; and by "constitutional," I mean formed by some vicious action, some error of assimilation which has become more or less inherent in the system. Now, the large majority of renal and vesical calculi are of constitutional, and not of local origin. When they are local, we can do little to prevent their formation except by mechanical means. Calculous matter, the elements of which are produced in the bladder, may be washed out, or be broken or dissolved, and then washed out. But when stones are of constitutional origin—and we are going to refer entirely to these to-day—their component elements are separated from the blood, and no mechanical mode of preventing their production can by any possibility be available at this early stage.

Now, from observation, we know that nineteen out of twenty of such stones have uric acid for their basis, the remaining one in twenty being oxalate of lime (the deposits of oxalate of lime and of uric acid so often replace each other, that the consideration of the latter becomes practically gener-

ally sufficient for our purpose); and, less commonly still, there are phosphatic stones which are of constitutional origin also. Therefore, practically, to all intents and purposes, the problem before us is contained in the question: How may we best prevent the formation of uric-acid calculus?

Let us examine the early history of a case of persisting uric-acid deposit. First of all, let me say that, with some individuals in whom the tendency to manifest it is very marked, it is often more or less hereditary. As an illustration on the spot, let me recall the man we have just seen with uric-acid calculus in the ward, of whom we learned that his father had "gravel or stone for the last twenty years of his life." And it is by no means an unusual experience, that either calculus or gout—more commonly the latter—has been observed in the family of the patient who comes to us with one of these formations in the bladder. We speak of tubercular disease and of cancer as being transmitted by blood-relationship, especially the former; but it is probably not more strongly hereditary than the disposition to uric-acid deposits in one form or another. I have made a point of asking the question of all patients who come to me with this complaint; and although I cannot furnish you with an exact numerical statement, I do know that in many, either gout or gravel (for I wish to show you the identity in regard to origin of these two complaints) has existed in the preceding generation. This hereditary tendency varies in force or strength in different families. You will find some persons with persisting uric-acid deposits at thirty years of age or sooner, others at forty, others not until sixty. Of course, the earlier the age at which it appears, the stronger you will infer the hereditary disposition to be, and the more obstinate, probably, will be its tendency to persist.

What, then, are the first signs of this condition in the patient? The first thing which excites his attention, usually, is the frequent occurrence of a pinkish deposit at the bottom of the vessel in which urine has stood, often staining the surface more or less. Or, the secretion, passed originally perfectly clear and healthy in tint, has become thick and opaque (sometimes almost resembling a mixture of rhubarb and magnesia) soon afterwards. Or sometimes a delicate film or pellicle appears, and covers it, exhibiting a faint play of prismatic colors. In fact, these changes occur on the cooling of the

urine under certain conditions. These phenomena therefore may appear more frequently in winter than in summer, because the external temperature is lower. The change consists in a deposit of salts from a hot solution, as the liquid cools; the deposit being easily redissolved by raising the temperature of the urine to that at which it was originally passed, when it regains also its original transparency. The condition here described very often and very unnecessarily excites much anxiety on the part of the patient; but only a very marked and persisting condition of it can be regarded as a sign of what by some is called "the uric-acid diathesis." Mind, I mean strictly persistence, or, at all events frequency of occurrence: for you or I, with no hereditary predisposition, may take a little more beer, or a heavier dinner, than usual, or an extra glass of champagne, or a glass or two of extraordinary port, and may find next morning a considerable quantity of this pinkish deposit, or the urine looking almost like pea-soup, but not so thick, and when the vessel is tilted on one side, a tidal mark, so to speak, is seen, showing the height at which the liquid stood; all this, as I said before, being redissolved by heat. The same condition may occur also after unusual exercise which has produced abundant sweating, so that only a small quantity of water is available in the system for the solution of the urine salts, and the secretion is high-colored, and contains an unusual proportion of solids. In either case the opacity of the liquid, as well as its tint, which may vary from fawn to dull red, are due to the unduly large production of the mixed urates; that is, urates of soda, potash, lime, etc. But if, without any errors of diet, among which any but a very small allowance of alcoholic drink is only one, a patient habitually passes this kind of urine—if in time there frequently arrives also a deposit of uric acid, manifested by the presence of little crystals, looking like particles of cayenne pepper, or red brick-dust, at the bottom of the vessel—when this occurs rather early in life, say before forty, we cannot doubt that there is an undue tendency to produce uric acid, either inherited or acquired. For this tendency may no doubt be acquired, or a pre-existing habit may be intensified; indeed, it is often the result solely of improper diet and regimen. I now show you a specimen of urine quite cloudy with mixed urates, although you must be familiar with it in the wards, and also

with the fact that on heating the liquid it again becomes clear, and that in a short time, while we are talking, if the room is cold, it may again become cloudy on cooling. Let me once more remind you that this may occasionally happen with the most healthy individual; and it is only the persistence of the symptom, without any flagrant errors of diet, which should lead you to suspect it to be a constant condition that requires treatment.

We have followed the complaint up to the formation of cayenne-pepper crystals. Of this deposit I have some very good specimens here, which have been collected from patients who passed it habitually. These consist mainly of the transparent rhomboidal uric-acid crystals, which you know to be very beautiful objects under the microscope. They may be passed almost daily and habitually by some persons, and without any sense of discomfort, or occasion for complaining. Other persons may pass this material periodically in large quantity, little or none of the deposit being observed during the interval. At such periods, the patient often experiences pain in the back, or over one hip, with uneasiness extending to the groin and testicle, all this perhaps accompanied by sickness or nausea; and he may then be said to have a mild attack of sand or gravel. He feels relieved after the occurrence, which, just as a storm is said to clear the air, has freed him for a time from the effect of accumulation of morbid matter in the system. Sometimes, however, the symptoms are much more severe, and are often then believed necessarily to denote the passage of a renal calculus. But I have satisfied myself, after very large opportunities of observation, that in the great majority of these attacks, the patients have been merely the subjects of a "uric-acid storm," if I may use the expression; and that calculous matter has been eliminated in a soluble condition, although the process has been accompanied by pains sufficiently severe to arouse the suspicion that some concrete form of gravel has been passed, or has at all events been formed. These phenomena occur at varying intervals, and usually become more frequent or severe, unless the patient does something to prevent their occurrence. Subsequently, he may pass tiny calculi, which have the appearance of being rounded, or, at other times, rough and irregular aggregations of the same crystals. Or at a later period these bodies tend

in time to become larger, as large as small peas, or even beans; still specimens of the same product—that is, of uric acid, associated more or less with an alkaline base, such as those above named. Their transit from the kidney to the bladder may be accompanied by excruciating pain in the regions already mentioned, and by severe vomiting, lasting a few hours; after which relief often occurs somewhat suddenly. At the same time there are many large specimens of such "gravel" or small calculi passed without the patient being aware of the fact until he sees them excreted. Indeed it is by no means unusual, even in those instances where patients have voided such small bodies for a period of several years, that no pain or other sign of their existence is observed throughout. Where, however, the transit of the calculus is painful or difficult, some signs of it are generally manifest in the urine. Sometimes it is scanty, and merely very high colored; at others it is tinged with blood, and not uncommonly it deposits blood in that dark form which is described as resembling "coffee grounds."

Here, let me recall for one moment what I said as to the relation between gout and uric-acid deposit. I have sometimes seen these two complaints alternating, comparing one generation with another; gout, in its ordinary form of attack in the great toe, appearing in the one, gravel in the second, and gout again in the third. But the same individual may also have alternating attacks of gout and gravel. I have seen a patient who had suffered for years from gout become free from his attacks without known cause for several months, when he developed for the first time a uric-acid stone in the bladder. Lastly, the so-called "chalk-stones," which you have often seen infesting the knuckles and disfiguring the hands of elderly people in advanced stages of gout, are composed of the same material—that is, of uric acid, usually as urate of soda. The identity of gout and uric acid gravel, then, is unquestionable; they constitute two different series of phenomena, but both spring from one and the same root.

Now, what is the best mode of dealing with those patients who habitually pass the cayenne-pepper crystals of uric acid, or the small calculi? What mode of treatment will help to prevent the arrival of at least the advanced condition—namely, that of calculus too large to be voided by the patient? Gen-

erally speaking, I think such patients come under observation in a tolerably early stage, although it is obvious this is by no means always the case. Some are unnecessarily alarmed at a very early period, when the urine is only occasionally thick with urates. They are apt to mistake the opaque secretion for some important manifestation of morbid matter, and to become greatly disturbed in consequence. Indeed, some patients become almost hypochondriac through not knowing that such deposits are of little consequence at first, and can be easily treated. It is necessary to correct these false impressions, and explain the nature of the product, that in itself it is not a diseased one, only a normal constituent in larger quantity than is desirable. They should be made to understand that the original and normal form of urine is a more or less crystalline solid, that it is indeed passed thus by many animals; while in others, like ourselves, it must be first converted into a solution for convenience of storing in a bladder. This solution, then, owing to irregularities in diet, etc., occasional or habitual, varies in strength; and sand, gravel, or calculus can only be formed when the solution is maintained by undesirable circumstances in a too concentrated state. The urine is then generally found to be very acid to tests: of course, uric acid being in large quantity, that condition is a natural sign of its presence. It is little the worse for this perhaps; the bladder mostly tolerates a urine of full acidity quite as well or better than a neutral one. Nevertheless, the presence of a full proportion of acid has come to be regarded as sufficing to establish a principle, somewhat a crude one, of treating the complaint; and one almost universally adopted. In the circumstances described the patient has generally been prescribed the continuous use of alkalies. While, on the other hand, and with even less reason for such a course, when the urine is neutral or alkaline, mineral acids are persistently administered. This simple—indeed, too simple—view of the matter often dominates the whole of the treatment. In the former case, a certain quantity of potash, bicarbonate or citrate, or of soda, or of lithia; or benzoate of ammonia is administered for a long period; or the natural waters of Vichy, Evian, or Vals (carbonate of soda), Contrexéville (sulphate of lime chiefly, with carbonate of soda), or some other alkaline spring, are largely given; or the patient is perhaps sent to

drink the waters on the spot, there or elsewhere. The chief alkali is, as you see, carbonate of soda; whatever, however, be the form of it, provided enough be taken, these deposits will disappear; the uric acid will no longer be deposited; the urine will become less irritating; the annoying symptoms will be diminished or got rid of. And of course the patient is very much pleased with this new condition of clear urine and disappearance of all deposit. And you may naturally say, "What more can be desired?" Much: you have merely made his enemy disappear; he is by no means rid of its presence, for you have not checked the acid formation. The uric acid is there, and probably in quantity as much as ever; for the uric acid and urates are soluble in alkali, and you have only rendered them invisible. You really have the same condition as that described in the well-known fable of the ostrich, which is said to put its head into the bush when pursued by hunters, and, no longer seeing them, to believe itself secure. Just such is the security of the patient with uric acid who trusts solely to alkalies or to Vichy water. His surplus deposits have become unrecognizable by vision; nothing more. I do not go so far as to say the alkalies have been absolutely unserviceable as regards his constitutional state, but they will not improve it to any great extent; and when he leaves them off the acid shows itself again. And further, I believe there is reason to conclude that large quanities of alkali, habitually taken, exercise an undesirable influence, to say the least.

Diuretics have been employed on much the same principle, and may be regarded as no better than the alkalies. In those cases which are treated with such agents as nitrate or acetate of potash, etc., the secretion of water is no doubt increased *quoad* the amount of solids, and the solids are thus dissolved. The same thing happens with that remarkably general and always popular diuretic, so punctually and faithfully swallowed by the patient who has once obtained any medical sanction for its use—I mean gin, or whisky and water. In all such instances, what has chiefly been done is to stimulate the kidneys, already perhaps overworked, to do more. You have by no means cured the patient of his gravel, and may be happy if he is no worse for the remedies.

I shall endeavor to give you a sketch of such views as I have been able to form of the pathology of these cases; and,

speaking now with more confidence, I shall be able to point out an efficient mode of treating them. The problem they present has been brought before me with great force and frequency, since for many years my advice has been urgently sought by the calculous patient, after operation, as to what he should do to avoid becoming the subject of another. And many others in the early stages have sought similar aid, naturally feeling that the subject must have engaged my attention, in the earnest hope that they might escape the advanced stage.

Using then only broad and simple terms, as our time here and, I may perhaps add, the extent of our knowledge will not permit me to be more minute or exact in detail, I shall premise that the origin of those well-known symptoms which all agree to recognize as gout, as well as of a superabundant uric-acid deposit in the urine, is due to defective assimilation on the part of organs associated with or forming the primæ viæ. I am quite aware that it is common in practice to speak somewhat confidently of the liver, its action, and its states, although we have probably still much to learn about these. Many years ago it was the custom to talk and act as if we were thoroughly acquainted with the liver and its functions; but during the last fifteen or twenty years new light has been thrown upon the subject by the laborious researches of Bernard, Pavy, and others, and we have thereby learned how little we certainly know of its natural functions, still less of its action in disease. Thus, in the department of practical medicine, all were agreed that if there was one fact more obvious than another—at least since the time of Abernethy—it was the specific influence of mercury on that organ. Nevertheless carefully conducted inquiries render it doubtful whether the secretion of bile, at all events, is influenced by this agent in any degree whatever. There were other drugs, indeed, which were vaunted to take the place of mercury, yet always following at a humble distance, so to speak; but no one ever thought of disputing the fact that you could augment at will the bile secretion by administering that famous specific. I am not here to say whether that is so or not, but it seems to have been proved that there are substantial grounds for challenging our ancient faith in the doctrine so expressed. Observe that I have said nothing to underrate the value of the medi-

cine in regard of symptoms popularly associated with defects of some kind in the liver.

Bear in mind, then, that in speaking of the "defective action of the liver," or of "torpor of the liver," I merely use provisional terms, which most will easily understand as indicating more or less distinctly a certain set of symptoms. Let them be briefly described as mainly consisting of a constant, or almost constant, deficient excreting function by the bowels, sometimes, but by no means always, associated with impaired appetite, perhaps headache, nausea, depression, inactivity, and other signs of slow or uneasy digestion; some of these being absent if the diet is carefully selected, or if the patient lives in the open air and takes much exercise. On the other hand, not only the deranged digestion, but pains in the back and limbs referred to as muscular, may be frequently present. I cannot positively state whether those phenomena are really due to inactivity of the organ in question; practically, for us to-day, this does not signify much, but the current terms are still convenient formularies until better ones can be substituted for describing the condition in question.

Now, at the bottom of this tendency to uric-acid production there often lies what is thus understood as inactivity of the liver; and the true rationale of the unduly large formation of the urinary salts appears to be, that the liver together with the skin or some other organ performing inefficiently its excreting function, the kidneys have more work than is natural thrown upon them. Thus the solid matters of the urine, or rather some of its ordinary constituents, are augmented—not all of them, for urea is not necessarily increased, but uric acid is largely produced, and is eliminated not only in solution but in crystalline forms. Uric acid is very insoluble in water; and although the quantity thrown out may be quite soluble at the natural temperature of the urine (99° Fahr.), when this diminishes to 60°, 50°, or 40°, the acid is deposited, and when the quantity becomes larger still, even the ordinary amount of fluid associated with it at a temperature of 99° will not suffice to dissolve the whole, and solid uric acid is deposited in some part of the urinary passages. This deposit may take place in the kidneys themselves, giving rise, if not thrown off, to the formation of calculus, at first renal, but sooner or later generally becoming vesical. Now, if all this be so, the forma-

tion of uric-acid gravel is not by any means to be regarded as necessarily disease of the kidney; on the contrary, it may be regarded as the result of an active and capable organ vicariously relieving some other organ the function of which is torpid. The true remedy, therefore, is not to stimulate the kidneys, already overworked, by diuretics etc.—not, to use a familiar simile, to lash that horse of the team which is already doing too much work—but you are to seek the cause in that other one of the team which is doing deficient work, and that is, either in part or wholly, almost invariably the liver, in the sense already explained.

The treatment, then, which I advise you to pursue is to employ such agents as will stimulate the excretory action by the primæ viæ without depressing vital power. No doubt that a powerful agent for the purpose is mercury; and it is quite unquestionable that relief of the symptoms above alluded to is to be obtained in a remarkable manner by occasional small doses of that agent. For our purpose, however, it is not always necessary to use it, and there is a widely spread belief, grounded, in my opinion, on the reckless mode of administering the drug commonly followed in the early part of this century, that it is mostly injurious or dangerous, and to be discarded if possible. No such objection at all events lies against another class of remedies, the prolonged use of which has been of great value, I mean certain kinds of natural mineral waters. These I regard as greatly superior for the cases in question to taraxacum, nitric acid, podophyllin, the alkalies, and other vaunted "substitutes for mercury" as they are termed, in what is called "promoting the action of the liver."

Now the mineral waters which I am about to describe belong to a group of springs marked by a common and distinctive character, since all contain in solution sulphate of soda in considerable quantity, together with a varying proportion of sulphate of magnesia, besides less important salts. In studying these waters I wish you to observe with me the composition of them, and at the same time to dismiss to a certain extent from your mind the estimate of medicinal doses which you have acquired in the dispensary, and which necessarily belong to it; since small quantities of drugs, as they exist in mineral waters, act more freely than the same quantities combined after the ordinary pharmaceutical method.

You ask me for a demonstration, and I am quite ready to give it you. At the same time, let me caution you against regarding the small doses of mineral waters as having any affinity either in the matter of quantity or by the principle which regulates their administration, with what is understood as an "infinitesimal" dose. The difference may be illustrated thus: you know that you may give to A an ounce of "Epsom salts" (sulphate of magnesia), or to B half an ounce; for individuals are very differently affected, and each is probably freely purged; but the same effect will be obtained with one-third or one-fourth of those quantities if the patient takes it as prepared in Nature's laboratory—that is, in the form of mineral water. It is a curious fact, which I give as an ultimate one, and without speculating here on the cause of the difference. As a proof of the superior force of the saline combinations found in natural springs, I may refer you to the following experiment. If you will reduce by careful evaporation, as I have done, such mineral waters to their pharmaceutical condition of crystallized salts, you will find that they possess no more power than similar salts obtained by the ordinary commercial processes, and met with in every chemist's shop. Having been separated by evaporation, they no longer act with the energy which belonged to them when in the state of solution which the natural spring produces. You will therefore readily understand that it may be essential, at all events that it is desirable, to employ the natural mineral waters; since what are called "artificial waters," however admirably prepared, are simply pharmaceutical products, and are destitute of a remarkable quality which distinguishes the remedies they are designed to imitate.

	Sulphate of Soda.	Sulphate of Magnesia.	Carbonate of Soda.	Other Ingredients.
SALINE.	grs.	grs.	grs.	
Püllna	154	116	—	
Hunyadi Janos	150	148	—	
Friedrichshall	58	49	—	Little Iron.
Marienbad (Kreuz) . . .	48	—	9	Little Iron.
Carlsbad (Sprüdel) . . .	25	—	13	
Franzensbad	30		6	
ALKALINE.				
Vichy (Célestins) about . .	3	—	47	Little Iron.
Vals (Madeleine) about . .	—	—	65	Little Iron.

Here is a table of the waters which I refer to, with a com-

parative synopsis of their distinguishing saline contents, representing the number of grains (without estimate of the chloride of sodium and other less active agents which are also present) in an English pint. Below these I add two well-known alkaline waters.

The most concentrated water of the saline group is that of Hunyadi Janos, a Hungarian water which contains about two and a half drachms each of sulphate of soda and sulphate of magnesia in an English pint; next and nearly equal to it, is that of Püllna, which contains 154 grains, or about two and a half drachms, of sulphate of soda to the pint, and nearly two drachms of sulphate of magnesia. (The large demand which has arisen in this country for the "bitterwassers" or natural aperient waters of Germany has, of course, led to the appearance of new varieties. Thus, more powerful and so called "richer" products have come into the market. It should be known that the increased proportion of the aperient salt to the water in which it is dissolved is caused by artificially evaporating the product of the spring. Thus a constant quantity of the solids is maintained by carrying evaporation to a fixed point, determined by the specific gravity of the solution. Water having been thus artificially removed, there is no objection to the addition of a considerable quantity of hot water to them when used here, for the purpose of diluting the solution, but chiefly for raising the temperature to at least that of the interior of the body, a condition which appears to render their action more certain and prompt. The difference in the composition of these waters is not great. Those that contain the largest relative proportion of soda sulphate to magnesia sulphate are, I think, superior for the purposes referred to above.) Those quantities of the commercial salts would give a tolerably efficient purge to most persons. But you must not give a pint of these natural waters to any one; five to seven ounces would be a full dose. I do not like Püllna generally for our purpose, because it purges too freely, often gripes, and is very nauseous; Hunyadi Janos is less so. Half or two-thirds of a drachm of sulphate of soda and half a drachm of sulphate of magnesia in a natural mineral water is an average efficient aperient for a man. Supposing that we order Friedrichshall, which contains not a drachm of sulphate of soda in a pint, and little more than three-quarters of a drachm of sul-

phate of magnesia; yet nine or ten ounces make an efficient purge; for many persons six or seven suffice. I think I may say that seven or eight ounces is, for the adult, an average dose; it should be warmed and diluted by adding, say, a third or a half of its bulk of hot plain water. But I know no difference between this and Hunyadi Janos except that of the latter two-thirds of the quantity named is an equivalent dose, and is more convenient in consequence. If then a dose of either be taken in the early morning, an hour before breakfast, which should be a light meal, but comprising the cup or two of hot fluid usually then taken, a full, free action of the bowels will probably follow soon after; perhaps two. That quantity, you see, would contain about twenty-five or thirty grains of sulphate of soda and twenty or twenty-five grains of sulphate of magnesia, which, administered in any combination you please from a druggist's drawer, would have little appreciable action: the patient might be uncomfortable perhaps, but there would rarely be any marked action of the bowels. To repeat what I have said: if you evaporate a quantity of Friedrichshall or Hunyadi Janos water in a warm-water bath so as to avoid decomposition of the salt, and retain the water of crystallization, thus obtaining as perfect a product as a chemist can produce, and administer three times as much of this salt as that which exists in a dose of the natural water, you will probably not produce such efficient or certain results as the small quantity contained in the natural water ensures. So that there is something, which I do not pretend to explain, and certainly shall not speculate about here, which distinguishes the action of mineral waters from the action of salts which are made by our pharmaceutical processes. I may appropriately remark here also, that the action of the aperient bitterwasser on some persons is such, that the longer it is taken the smaller is the quantity necessary to attain its object. If, for example, six or seven ounces taken in the morning with, say, four ounces of hot plain water, produce one movement of the bowels immediately after breakfast, the next morning five ounces, and a morning or two later three or four ounces will do the same; and it is not improbable that at the end of ten days or so, three ounces or thereabout will produce the desired effect.

The next water on my list is that of Marienbad, and it contains forty-eight grains of sulphate of soda in the pint, with

nine grains of carbonate of soda, no sulphate of magnesia, but a small quantity of iron. With these constituents, there is enough free carbonic acid to make it an agreeable and slightly sparkling draught. Rather more than half a pint produces for most persons an easy motion. If this water is exposed to the air for a day or two, there will be a brown deposit of the iron; it is indeed to be regarded as a slightly ferruginous water although this character is not an important one. It is a very admirable form for many persons where the action is not required to be considerable; while the presence of iron, and of carbonate of soda, is an additional advantage for some. The only drawback is the need that it should be obtained in a fresh condition, for it bears transport badly, soon losing its carbonic acid, and depositing its iron, and thus becoming less palatable and light for the stomach. This difficulty has been partially overcome of late by the use of better bottles, and by the increased demand which is gradually arising for it.

Thus much for the saline aperients. We now come to the water of a very famous spring, that of Carlsbad, which is credited with the possession of a quality or influence, conventionally denoted by a somewhat vague term, "alterative," being undoubtedly useful for patients who habitually consume more food than the system and its activity demand, and who manifest, as a consequence, obvious signs of superabundant uric-acid deposit. The patients, however, should be fairly robust; feeble and excitable persons are usually depressed and injured by Carlsbad. There are several sources there, all of which contain about twenty grains of sulphate of soda, and thirteen of carbonate of soda in the pint, and contrary to the common belief are identical in their chemical constituents and proportions. They differ from each other solely in point of temperature, which is very high in the Sprüdel, the central source, and in the remotest is higher than that of the human body. Carlsbad water is often supposed to be purgative, but it is not so unless taken very largely. No quantity ever given here exerts a laxative action on the bowels. The influence it exercises on the animal economy, although probably chiefly due to the sulphate of soda element, is not in any way as an aperient. The "Carlsbad Salts" (which are widely and popularly known as an aperient, but are sold at an exorbitant price, bringing a

great revenue to the Carlsbad makers) are simply sulphate of soda, or "Glauber's salts" (with perhaps a trace of carbonate) and differ in no respect, except in name, from that common but valuable aperient as made here at home and in other countries. My belief, after a long and large experience of the employment of Carlsbad water in this country, is that in most instances it is more useful here than when taken at the spring itself. This I will explain presently.

Next to be named is the water of Franzensbad, which contains thirty grains of sulphate of soda, six of carbonate, and a little iron, which Carlsbad does not. That closes this group of springs.

Next I shall just point out the distinctive characters of the alkaline waters which are so popular in this country. First and best known is that of Vichy, which contains only three grains of sulphate of soda, but nearly fifty grains of carbonate of soda, in the pint—a powerful solution. After that is the water of Vals, which is also from the volcanic district of France, some of the springs of which contain upward of sixty grains of carbonate of soda in the pint, and nothing else worth mentioning. These two waters are extremely famous, and their sources are much resorted to by patients for the cure of gout and gravel. The waters are also largely exported to other countries. Another alkaline water is that of Evian, on the south shore of the Lake of Geneva, which I name here because it has a certain reputation as a resort for calculous patients. The alkaline constituent, carbonate of soda, is present, however, in much smaller quantity than the preceding, and this spring ranks, as regards the influence of that agent, below the others named.

Contrexéville and its water have of late been more recommended, especially by the profession in Paris, for calculous patients. No doubt some alleviation of symptoms is thus obtained by certain patients; but the constitution of the water, which depends for its alkaline action chiefly on a salt of lime, renders it an undesirable agent for the object we are now seeking to accomplish.

Under the continued daily use of strong alkaline waters, the uric-acid deposits disappear—that is, they are dissolved by the alkali. Inasmuch, also, as this appears to have some beneficial action on the liver, a certain degree of benefit is

perhaps also attained. Thus such patients are often better for a time after a visit to Vichy; but, as a rule, are not permanently benefited. I am satisfied, after observation on the spot, and also of the effect of the waters taken here, that they only temporarily mitigate the complaint, and do not cure it. Now, the principle upon which the waters of the sulphate of soda group, aperient and non-aperient, are beneficial is, that they produce activity in all the digestive functions, stimulating the excretory action of the abdominal organs, so that certain waste matters which have been hitherto thrown out as uric acid by the kidney are eliminated in some other form. If, therefore, it is really desirable to recommend resort to a mineral spring as treatment for uric-acid deposits, I should prefer Carlsbad, and certainly never send a patient to Vichy, Vals, Evian, or Contrexéville. And when a stout active man, whom it is most desirable to separate from his home engagements and business cares, requires a Carlsbad course, he may often visit the locality with advantage. At the same time, as I have already intimated, I firmly believe that it can in the majority of instances be more successfully pursued at home, provided certain concomitant advantages can be secured, than by sending the patient abroad. Thus it is desirable to secure, during a course of waters at home, at least regularity of meals, scrupulous attention to diet, and to select a time when, particularly in the case of business men, less of anxiety and of need for overexertion than usual, may be expected. Granted these conditions, there is one advantage in the home course which outweighs much of the special value of a course on the spot. The patient who stays at Carlsbad three weeks, very rarely four, is made to consume far too large a quantity of water in a given space of time. The quantity in itself is probably not too much for his needs; but it is more efficacious, and is less exhausting in its effect on the patient, to devote two or three months to the task than to swallow the whole within the brief term named. It is the apprehension of this fact which has made me so warm an advocate for the systematic home use of these agents, at all events for the class of cases which we are here considering. There are some other maladies for which Carlsbad is recommended, but relative to these it is not my province to offer you any opinion here.

But I shall now endeavor to illustrate with more detail the

manner of administering the waters which I have pursued and now advise.

A patient seeks your aid, on account of a series of severe renal attacks occurring at considerable intervals of time, after one or two of which he has passed small pisiform calculi of uric acid. His health may appear to be otherwise good. On the other hand he may be also troubled with some indigestion; in either case he is very likely more or less constipated; and you will probably find that, relatively to his activity of life, his amount of food and stimulant are somewhat excessive. I advise you to give him at the outset half a grain or a grain perhaps of blue pill with three or four grains of the compound extract of colocynth at night, followed next morning by six or eight ounces of Friedrichshall water, or half that quantity of Hunyadi Janos, taken with a little hot plain water. Then, on each succeeding morning, let him take six ounces of Carlsbad, with about two ounces of Hunyadi Janos, and four of hot water daily, say until the end of the first week. If the bowels are not moved at least once easily, soon after breakfast, increase a little the quantity of the aperient water; if, on the contrary, there is more than gentle action, diminish the dose. I then usually order four, five, six, or seven ounces of Carlsbad every morning, according to the patient's condition and temperament. If he is delicate, irritable, more distinguished by activity than by force, his occupations demanding intellectual rather than muscular exertion, the smallest amount may amply suffice. If he is a robust countryman, taking much physical exercise in the open air, the largest quantity may be a moderate dose. For two or three weeks or thereabout, the waters may be taken every morning; after that, every other morning for another month or more, and so on according to circumstances. The Carlsbad should be the chief agent throughout, but since it has no aperient action, with some people appearing rather to induce constipation, and as moreover the presence of the water in the system, for a few hours after taking it, sometimes seems to cause uneasiness and to be injurious rather than the reverse, it is desirable for a large proportion of patients to add a little Hunyadi Janos, just enough to induce one gentle action of the bowels after breakfast. The quantity of this must be decided by each individual according to his own experience of its effects. When the

bowels act freely without it, as occasionally happens, the Carlsbad may be taken alone; and in all cases it should be heated. At the source it is too hot to drink, and is allowed to cool slightly; and when it is taken here a little hot water may be added, or it should be raised in temperature to 90° or 100°, by placing the tumbler containing it in a vessel of hot water for a few minutes.

I have largely and systematically employed these agents for about five and twenty years, modifying the quantity and the mode as experience has indicated, and the system thus briefly described is the result of it. After a course of six weeks or so it may be repeated with advantage, for many patients after an interval of three or four months. Meantime, as an occasional aperient and as a corrector of digestion in these cases, few things are better than the aperient waters named. I referred just now to the well-known "Carlsbad salt" as being often used in the belief that it represents Carlsbad water; on the contrary, it consists almost entirely of sulphate of soda taken from the water, and has just the same and no more virtue than that salt when obtained from any other source. But sulphate of soda is one of the most admirable medicines we possess, and deserves to be more popular than it is. I have constantly ordered it, with or without a small addition of sulphate of magnesia, for the out-patients of the hospital, as the best substitute within their reach for the mineral waters in question.

There are many cases, especially those in which the patient has been in the habit of consuming more food, and especially more fatty material, than he has been able to assimilate, for which a few small consecutive doses of blue pill may be most usefully employed. I am quite satisfied in most instances with an eighth of a grain combined with two or three of the compound extract of colocynth, or with four or five grains of compound rhubarb pill, taken every third, fourth or fifth night, during the former part of the course. Many persons in whom doses of two or three grains of blue pill cause painful depression derive manifest benefit from the small quantity named. If anyone whose habits or condition have occasioned beneficial recourse to the remedy doubts the effect of an eighth, a twelfth, or even a twentieth of a grain of blue pill, let him try the ordinary five-grain compound rhubarb pill, with and without the

fractional addition, and the difference will be easily understood and appreciated.

And smaller doses even than these are of great service when habitually taken for a short time by some of these patients who have been the subjects of indigestion. Heavy feeders, large consumers of animal food, are little affected by such minute quantities. But when the habit of living largely on cereals, vegetables and fish, with perhaps game and poultry, and little or no meat, has been acquired—which, as we shall soon learn, is a powerful means of checking uric-acid deposit, and rendering the individual hitherto affected by it not only free from his local troubles, but stronger and healthier than before—the minuter doses referred to act with ample effect.

Of this system of treating a constitutional tendency to excrete uric acid in abnormal quantity, whether in the form of calculus, or by the less obvious course of gouty attacks in all their varied manifestations, I cannot speak too highly. I know no results in my entire personal experience of practice which have satisfied me more, or have better earned a right to be considered successful than those which have been thus attained.

But the important subject of the necessary dietary and hygiene for these cases must now be deferred to the next lecture.

LECTURE II.

THE DIETETIC TREATMENT OF PATIENTS EXCRETING URIC ACID IN EXCESS.

Gentlemen: A growing experience of man and his needs, and especially of that class of our follow-creatures who on account of some defect of health come under professional observation, has increased my sense of the importance of studying closely the subject of diet and digestion in relation to their ailments whatever they may be. Emphatically a surgeon, I nevertheless find that subject full of interest, and, what is more, believe an acquaintance with it to be the necessary complement of surgical tact and prowess: inasmuch as the right understanding and management of the stomach and its wants, in a sick-room as well as out of it, conduces largely to the success of operative treatment. I request you, therefore, not hastily to conclude that I am quitting to-day—no, not in the smallest degree—the surgical track which is my department here, but, on the contrary, that I am distinctly and essentially remaining within it. Hence it is that for the first time I take the course of extending the remarks on diet which formerly occupied but the latter third of a preceding lecture, for the purpose of expounding my views thereon more fully than heretofore.

You will recollect that in considering the early history of calculus, I suggested to you a point of view from which the patient excreting uric acid in excess might be regarded, and at all events successfully treated, chiefly through the influence of certain natural mineral waters containing sulphates of soda and magnesia, which act primarily on the organs of digestion. And it is therefore only natural to suppose that the right regulation of the diet of these patients must accompany the medicinal treatment. Indeed I am quite satisfied that in nineteen cases out of twenty, probably in a larger proportion than that, an undue deposit of uric acid will disappear under a proper

dietary. At all events, the formation of it in calculous masses can be prevented, and the patient spared the pains and the anxiety connected with their production and appearance. I think as much may be said of oxalate of lime deposits.

It was formerly held that when a patient excreted uric acid superabundantly, that the obvious and chief course is to diminish considerably the nitrogenous elements of his food, since uric acid contains a large proportion of nitrogen. But this very simple view of the matter will not furnish the secret of successful treatment, as the endeavor to realize it in practice has long ago demonstrated for myself, and a like conviction must also have arrived to others. For many years past I have pursued a widely different course, and with results which warrant the statement just made.

Speaking then in general terms, the two classes of food which it is necessary to eliminate from the dietary of those who have been excreting uric or oxalic acid abundantly, but especially the former, are, fatty matters, and saccharine products of all kinds: the former not entirely, the latter as completely as possible. Next, alcoholic drinks should be forbidden, or, if permitted in some exceptional cases, should be taken only in very small quantity. Let us get rid of this subject first before proceeding to that of food properly so called. There is no doubt whatever, that the great majority of these patients are better without fermented or spirituous liquor in any form. Its habitual use for healthy persons is undesirable and injurious as a rule, to which there may possibly be a few exceptions in this world of infinitely varying conditions. And for patients with impaired digestive power it is usually still less desirable. For those who have the symptoms before described as depending upon a "torpid liver," alcoholic drink of any kind is, I believe, invariably pernicious; its daily use in very small quantity creates the condition so termed for thousands, and is the cause of an infinite number of chronic cases of obstinately recurring, although slight, "sick headache," "bilious attacks," as well as much of the malaise, and incompetence, mental and bodily, attributed to a slow digestion.

But after long indulgence even in a small quantity of alcoholic stimulant, many a patient misses it exceedingly, and when commencing a habit of abstaining rises from a meal, however ample, complete and varied in the matter of provi-

sion, with a sense of dissatisfaction only to be appeased by that little modicum of liquor which has been absent. Of course this is the expression of a want artificially created, and it is very hard to stifle that craving. It will make itself felt for months perhaps—I speak of exceptional cases—and explains many of those in which an individual tells you, "I tried total abstinence for six weeks, or two months, and found I could not stand it." I will even concede that for a time he may have digested less easily and profited less by his food than he did when he took the stimulant; but this condition you may assure him will continue only for a time. Perseverance in abstinence, with a rarely permitted recourse to relief in unusual circumstances, will be rewarded in the course of a few months. Three, four, or even six, may pass before the digestive functions will regain their normal power apart from the artificial stimulus, and then they work better than before; and thus the patient reaps, if he faint not, the reward of his well-doing. When you admit some compromise in the matter, generally advise a sound light wine, the ordinary produce of the Moselle if possible; in its absence, that of the Rhine, or (now more difficult than formerly to obtain pure of common table quality) Bordeaux. But certainly forbid most champagnes and other effervescing wines, as for the most part imperfectly constituted, and always bad if containing much of the sweet compound often largely added and known as "liqueur." The stronger wines, as sherry and port, are always unsuitable, and strong beer is to be absolutely forbidden. Very light bitter beer, or sound cider which is neither sweet nor acid, is preferable to any of these if any alcoholic stimulant is to be taken. They might be so made in this country as to be at all events as wholesome as any wine wherever it comes from. It is a pity we do not produce here a very light alcoholic beverage from malt and hops which might be less injurious, and infinitely cheaper than any compound which is imported from abroad. While the apple, and possibly other fruits, with increased skill in the making would offer agreeable variety. All such products should be perfectly dry, that is, containing no free saccharine. Solutions of pure spirit and water may perhaps be permitted by exception for a very few of those who really require such stimulus.

But it is in the matter of food that there can be no com-

promise if it is intended to arrest the progress of calculous formation when it has once commenced. I have but one preliminary observation to make, always essential to be considered before defining strictly a dietary for any person. It is this: that when proposing to lay down a plan of this kind, whatever the object in view, the prescriber must ascertain the patient's habits, and especially what amount of bodily activity is habitually enjoyed, or demanded by the daily occupations of his life. It should be unnecessary to tell you, that where severe or prolonged muscular exertion must be sustained, in laborious occupation or in the pursuit of sport, more hydrocarbons and a little more nitrogenous food are desirable than for the sedentary man whose time is chiefly spent at the desk, in the office, in the courts, in the studio, in the carriage, and who has, moreover, but little opportunity for exercise. Make yourself acquainted with all his habitual modes of expenditure in the matter of physical energy, before furnishing detailed instructions as to the food which is to support it.

And not less is the age of the patient a matter of considerable importance. Let me insist on the truth of a doctrine which ought to be more familiarly known and acted upon than it is, viz., that all who have reached an age at which capacity for active exertion is diminished, should maintain a similar abstinence from such food, in order to insure a continuance of health and comfort. There is no more common, and perhaps no more flagrant popular error than that which is responsible for the practice of constantly "supporting," as it is termed, those who manifest the debility of age by augmenting their supply of food. It should be remembered, that all excess of nutriment over the power to assimilate, and also to employ in healthy activity when assimilated, must inevitably overtax the excretory powers, and become a source at least of discomfort, if not of disease. In short, when sedentary or generally inactive habits are induced, whatever the cause, whether through debility, accident, or age, highly nutritious diet, and especially a large proportion of hydrocarbons, is almost invariably prejudicial. This being premised as a general principle, I shall add that, for the calculous patient in particular, it is essential to enforce a very sparing use of fatty matters in food. If he is already stout, weighing some ten to twenty-five pounds, as often happens, more than the average attained

by healthy men of active habits, the abstinence should be strict; and the gradual reduction of his weight insured thereby will, within certain wide limits, denote the measure of his improvement in relation to his calculous tendency. In order to insure a steady but gradual diminution of bulk, the patient should always be weighed by his adviser, and the amount registered for comparison week by week, that the effects of the change in diet may be accurately observed. A loss of four or five pounds during the first month will almost invariably be attended by a sense of increased power, of agreeable disposition to activity, in the place of pre-existing torpor, lassitude, and oppression. During the second month the diminution will be less; in the third less still, by the end of which time another three or four pounds or so will be taken from the heavy burdens which have afflicted the corpulent patient. When this condition is not present, a less rigid regulation in relation to fatty matters is necessary; although in all such cases they must be permitted in very moderate quantity.

What are the ordinary foods in daily use which largely contain the objectionable elements, and must therefore be more or less avoided? Milk, cream, butter, cheese, eggs (especially in the form of omelette), creams and pastry; fat pork in its many forms; suet in puddings and pastes, the fat of roast and boiled meats, etc. The homely rice or sago pudding, chiefly compounded of milk and egg with sugar, so excellent for our children, and for healthy active people—type of simplicity; I might almost say, of the domestic virtues—is in the last degree objectionable for your uric-acid-making, gouty patient. Nevertheless, all the farinaceæ may be used so as to furnish desirable dishes in the nature of puddings, if made savory, not sweet, with light broths instead of milk, using eggs in moderation, some condiment (a pinch of curry, or a few morsels of chutney) instead of sugar. Then next all articles of food, whether natural products or artificially combined, which contain sugar, particularly cane-sugar, must be expunged absolutely from the list of aliments permitted. I do not enlarge further here on the principle on which this advice is given. There is much to be said thereon, but this is neither the time nor the place for discussing the subject at great length. Suffice it to add that abstinence from the substances named probably lightens considerably the work of the liver, and so

lessens manifold vicarious forms of activity on the part of the kidneys in accordance with the views already propounded. Let me just advert, however, to the dietetic system in force at Carlsbad in relation to the patients in question. Apparently in recognition of the principle explained above, the use of sugar and of butter is absolutely forbidden during a Carlsbad course; and were one of you a patient there, your purveyor would not supply you with the forbidden food, however much you might demand it. I can only say, as the result of observation, that this system, far more than that of eliminating meat from the dietary, will reduce the uric-acid deposit. By forbidding everything that contains sugar, and diminishing considerably all fatty matter—permitting nitrogenous food in fact, although only in moderate quantity, and diminishing greatly hydrocarbons—you will generally accomplish more than by the contrary method.

What then is the dietary to consist of? Fish in all its forms, except those which contain much fatty matter, as herrings, mackerel, eels, and the under part of the salmon. Game in all its forms and poultry; lean meat in moderate quantity, besides preparations of gelatine, often welcome and useful as savory jelly as well as that which is otherwise agreeably flavored or acidulated, but unsweetened. Butter in moderation is the only direct form of fat, some being necessary, which I am in the habit of permitting, as well as an egg or two, without which cookery is impossible, objection relating solely to the yolk or fatty part, and milk in strict moderation. Well-made bread, especially that which contains every portion of the wheat grain, outer envelope or husk included; oatmeal, pearl barley, macaroni, and the Italian pastes; all can be easily presented in numerous simple yet palatable modes, by the exercise of very little culinary intelligence, and ought to occupy a large place in the daily service of food.

In relation to whole-meal bread for daily regular use, let me pause an instant to remark that the value of inert matter as an essential part of our food seems to be quite lost sight of in the search for "nutritious and supporting" elements, unmixed if possible with any other. Even so-called "bread reformers" vaunt as an improvement their elaborate processes of ridding wheat meal of every particle of what they are pleased to regard as useless matter. Few people appear to

know that most of the habitual constipation, so generally complained of, is due solely to the fact that modern civilization demands the elimination of everything that is not nutritious from our food, the consequence being that there is very little inert substance left after digestion to produce a fæcal mass for the muscular intestine to grasp and transmit. The cereals and green vegetables, when employed in their nearly natural conditions, furnish for this very useful purpose a quantity of inert material, which a well-meant but blundering interference officiously removes. It is quite remarkable to what a large extent this important element of food is ignored, even by professed authorities on diet, unless its value be not, which is more probably true, wholly unknown and unsuspected by them. I may add that the whole-meal bread, which is on this account so valuable, may be improved, both in flavor and texture, by an admixture of fine, not coarse, Scotch oatmeal, in the proportion of one-fourth or one-third to the wheat-meal employed.

Another class of vegetable products of great importance on the ground of the nutritious elements, especially nitrogenous, which they contain, is presented by dried haricots in all their varieties and lentils. These are capable of furnishing excellent dishes, often preferred to joints of beef and mutton, which they may sometimes advantageously replace. They may also enter into the composition of soups in the form of purée, valuable for the ease with which they are usually digested and the amount of nutriment contained, especially to those whose occupation is active and demands physical exertion.

The less nutritious class, the farinaceæ, as rice, sago, tapioca, arrowroot, etc., are all useful treated in the manner above incidentally referred to, that is, as savory dishes and not as sweets. Fresh green vegetables are especially to be recommended, and are worth bestowing some pains on, to obtain good and cook well, when they may form an important item of the list. The fresh legumes, such as green peas, young broad beans, etc., are valuable for most people, although a few do not digest them easily, especially if time is not given to mastication and insalivation (absolutely essential, not only for digestion, but to secure all their nutritious elements), however tender the vegetable product may be. Some persons can

digest a light salad; others can eat no vegetable until it has been cooked; and no rule can be made applicable in all cases respecting it. Celery and seakale, asparagus and tomatoes, the potato and the artichoke, are important items on our list to which I know of no objection, although the potato has been often, as I think unnecessarily, excluded from it. Apples may generally be permitted, best when roasted or baked, without added sugar; but rhubarb, strawberries, raspberries, gooseberries and currants, grapes, plums, pears, and all sweet fruit, native or foreign, must be rejected without hesitation, whether fresh or preserved. For those persons who feel the loss of sugar in diet, as that of a luxury highly prized, and there are many who do so, no objection can be made to the use of the recently discovered product "saccharin." It exerts no action in the body akin to that of cane and grape sugars, and appears to be quite harmless in every respect.

Milk, already referred to, is very undesirable as an article of diet, both on account of the large proportion of fat and sugar it contains; while its nitrogenous principle, casein, is by no means a universally digestible element. At the same time a small quantity, to be taken with tea, coffee, or cocoa, not in the proportion usually adopted for "café au lait," may be taken without hesitation of course. In large quantity it is not only noxious, but is often digested with great difficulty by the class of patients now under consideration. Thoroughly skimmed it is less objectionable, although the remaining elements render caution in the matter of quantity still desirable. In the same way, there is no objection to the use of the white of egg, so valuable in cookery; the yolk being, from the large proportion of its oily constituent, the part which should be eliminated or employed with great moderation.

Here, I think, is a range for choice by no means to be complained of, at all events for a class of patients whose dietary must, in some important particulars, be strictly curtailed. Modifications can and should be made by minimizing or augmenting the relative proportion of animal and vegetable elements according to the engagements, surroundings, or idiosyncrasies of the individual.

I next remind you after this brief, but still sufficient sketch of the principles of the dietary, that other points of hygiene must be attended to, when conformity to the first and chief

has been insured. Thus it is essential to stipulate for a certain amount of muscular exercise, some to be taken in the fresh air daily. Quite as important is attention to the healthy action of the skin, encouraging this by a habit of simple daily bathing in the bedroom, following it by friction of the surface of the body in some efficient manner.

But the first-named object as well as the second may to some extent be accomplished by the same process, and by no better mode than by the systematic use of the flesh brush. I have long recommended for this purpose a brush specially made with rather soft bristles of unequal lengths, so as not to present an even flatly cut surface, which latter effects the object imperfectly. The soft uneven bristles gently penetrate between folds and flexures, or follow the varied contours of the body, without irritating, much less abrading the skin. A pair of these, each with its strap passing over either hand of the user, systematically applied for five or ten minutes every morning, afford a capital form of exercise for those who have little opportunity of obtaining it sufficiently out of doors, and so for the middle-aged and elderly man offer an equivalent to the club or dumb-bell performance of the young and hearty.

At this period of life the capillary circulation of the skin mostly becomes languid and deficient, if not stimulated or provided for by some special means. Hence it is that unnatural dryness of the skin, harshness, chronic eruption, coldness or partial insensibility of the surface are so often experienced by elderly people. By daily gentle applications of the soft brush, circulation of the blood in the superficial capillaries is produced, and a skin which has long been dry, rough, and inactive may in a few weeks be rendered soft, supple, and vascular, like that of a healthy person in middle life. Better still, such a skin performs its functions and takes its share of work among the other eliminating organs of the body.

It should not be forgotten that with the diet described, some increase of clothing is usually necessary. There is no doubt that thicker coverings in spring and winter are felt to be necessary now, than when food more rich in fat was freely consumed. On the other hand it is a marked and agreeable experience for many, that the oppressive heat and the plague of thirst which so many complain of in hot summer weather are unknown to the consumer of diet which is chiefly cereal

and vegetable, with some fish and a little fruit. These matters are here named, being of essential importance, from their necessary and close relation to the subject of food and its functions.

Such, then, is an outline of the system embracing a regulated diet, regimen, and the use of natural mineral waters, which I have so long and so satisfactorily employed, and which I strongly advise you to pursue for the purpose of checking calculous disease in its early stages, and so preventing the formation of stone in the bladder in that considerable majority of cases which are occasioned by an undue formation of uric acid. I shall only add that I invariably advise it in a more or less modified form, but the dietary invariably, for all patients for whom I have once operated on for an acid calculus, in the hope of preventing the recurrence of any further product in the future. Nothing is more probable in a robust man of middle age who has once furnished such a product than the appearance of others in course of time. And you may wisely tell him this; but you may confidently add that if he will follow your directions, implicitly and not half-heartedly, you can very nearly promise him a future immunity from stone as the consequence.

LECTURE III.

ON THE TREATMENT OF STONE IN THE BLADDER BY SOLVENTS: ITS HISTORY AND PRACTICE.

Gentlemen: The inquiry as to whether it be possible by the use of medicinal or chemical agents to dissolve stone in the bladder, and so to avoid any operative proceeding for its removal, is one which has excited a great amount of interest at different epochs of our history. During many centuries this question has appeared and reappeared. Some accident calls public attention to it; interest is aroused, experimental trials of some new agent, which probably proves to be an old one in modern guise, are made, achieving little or no success; after which a cycle of indifference follows. Meantime, as the sum of these reiterated efforts, some sort of progress results. Nevertheless the subject is scarcely considered in standard surgical works, although it is one fraught with interest to us all. For myself, I confess, it has always had a degree of fascination. It would be so great a triumph to our art to dissolve the stone without damage to the delicate structures in which it arises and finds its residence. And thus it is that I have not only alluded to it in various works, but have discussed it at considerable length many years ago in one of them.

I propose, therefore, to tell you what has been done, and what at present, indeed, how little, appears to be attainable by the agents employed; endeavoring to sketch the history of solvents for stone in the bladder from the earliest period to the present day.

You know that the existence of calculus was recognized, and that a cutting operation for its removal, at all events in the cases of boys, was practiced, a few centuries before the Christian era. In course of time the attempt was made to dissolve it, especially in the case of adults. It appears that

neither Hippocrates nor Galen entertained the belief that this was possible. One of the earliest allusions to the practice is found in Pliny, who says that "the ashes of burned snails' shells are good for expelling the stone." Aretæus, in the second century of our era, recommends "quicklime in honeyed water" for the same purpose. Later authors, quoted by Paulus Ægineta (seventh century), speak confidently of the efficacy of goat's blood, and they observe that certain solvent remedies if administered to inappropriate cases may increase the size of the calculus.

Arriving at the period when medicine flourished in Arabia, we find numerous specifics and some extraordinary combinations of them systematically given. The celebrated Avicenna (about the tenth century) enumerates many substances supposed to be efficacious. He and others of his time employed occasionally an impure carbonate of potash; but as an example of the kind of prescription current at this period, I give you one of them in full, translated from Avicenna, as it is a curiosity, and gives you a good idea of the very complicated mixture which sometimes constituted an ancient medicine: "Take equal parts of calcined glass, of the ashes of scorpions, of the ashes of the root of colewort, of the ashes of a hare, of the ashes of egg-shells from which the chickens have escaped, of the stones found in the sponge, of goat's blood dried and powdered, of lapidis judaici, the same of parsley, wild carrots, marshmallow seeds, and gum arabic. Make it into an electuary with honey."[1]

Between this period and the fifteenth century we can mark no advance. About this time Basilius recommended the internal use of an alkaline salt, obtained from the cuttings of the vine in spring; this rests on the authority of Boerhaave.[2] Crollius, in his "Basilica Chymica" (Frankfort, 1608), recommended the patient to take a salt of tartar (carbonate of potash) in an infusion of parsley, and also some solutions of which lime was the principal ingredient. In 1650 Daniel Sennertus directs the internal use of the same remedies, and also that they should be injected into the bladder through a catheter. About the same time, Riverius, physician to the French Court, advises, as many others also did, the ashes of calcined egg-shells. The dose was a drachm of the powder, which was, of course, chiefly lime, to be given in white wine or

with diluents twice a day; and it is stated that "potenter expellit calculum in urinæ meatibus hærentem."[3] Numerous other authorities might be quoted as repeating all these receipts with little or no variation.

Next in order comes, in this country, the famous Mrs. Joanna Stephens. This lady had acquired so great a reputation in the earlier part of the last century, that in 1739 the English Parliament, after a formal inquiry, purchased her secret for dissolving the stone at the cost of £5,000—a circumstance which produced a large and remarkable literature during the next few years, and gave a great stimulus to research. The document which was obtained at this cost commences thus:—

"My medicines are a powder, a decoction, and pills. The powder consists of egg-shells and snails, both calcined. The decoction is made by boiling some herbs (together with a ball which consists of soap, swine's cresses burnt to blackness, and honey) in water. The pills consist of snails calcined, wild carrot seeds, burdock seeds, ashen keyes, hips and hawes, all burnt to blackness, soap, and honey."[4]

The quantity given was a drachm of the powder three times a day, mixed in cider or other liquor, and followed by half a pint of the docoction. If the decoction disagreed with the stomach, the pills were to be substituted. These compounds were found to be very nauseous, and were soon superseded by other agents.

After this, Dr. Whytt, Professor of Medicine in the University of Edinburgh (1761), brought soap and lime-water into favor, giving one ounce of "Alicant soap" and three pints of lime-water daily, and illustrating its use by a remarkable case or two.

In the practice of Blackrie (1766), Chittick (who made all his patients send locked cans of veal broth daily to his house that he might add the solvent and preserve his secret) and others, mixed solutions of potash and lime were much employed; and a considerable amount of evidence of their utility to allay pain was published on good authority. Soap lyes of different strengths furnished the potash in many cases; in others the "salt" of tartar was given, and always in a very diluted form.

In France at an early date alkaline remedies had many

advocates, such as Darcet (1726)[5] and Pierre Desault (1736). Morand, the famous surgeon of Paris, who came to London to report to the French Academy on Cheselden's operation of lithotomy, made also very careful observations on forty patients treated by Mrs. Stephen's remedies. He was unable to certify to a single case of removal by the solvent, but said that four "thought themselves cured." Much later, the subject of alkaline solvents was investigated by Fourcroy and Vauquelin; more recently by C. Petit (1834). The first and last named employed the Vichy waters. In Italy, Girardi (1764) recommended the use of solvents, but extolled especially the virtues of a decoction of uva ursi for that purpose.

Meantime the vegetable kingdom had been largely explored for the same purpose. It will suffice to give a list of a few of the principal plants so employed during the last two or three centuries. I shall name those only which enjoyed the greatest favor. The "Banke cress," or "saxifrage" (the name being due to its reputed virtue); its seeds boiled in decoction of couch grass; dose of the seeds, one drachm. Tincture of the "Pimpinella saxifraga." A tincture of the seeds of the "Lithospermum majus," or "great gromell." The decoction of "Broome;" a tincture of the seeds of "Fraxinella." Tincture of the root of the "Raphanus sativus," or garden radish. Tincture of the seeds of the common nettle. The marsh and yellow mallows, the couch grass, parsley, and the wild carrot were also ingredients in the compound decoctions employed.

And now I come to the experience of to-day. And I suppose you to inquire, "What are the existing resources available for a patient who desires at the present time to attempt the solution of a stone in his bladder?"

I shall divide these into two classes. First, there are the empirical remedies, which have a certain reputation; and secondly, there is the result of the latest investigation of the subject by scientific observers.

First, the empirical remedies. It is a curious fact that in almost every European country there exist certain persons who obtain a livelihood by making and selling remedies to dissolve the stone. The recipes employed are usually family heirlooms, and a sort of reputation clings to the family, each generation of which carefully preserves the secret, such as it is, and the traditions of their predecessors. In the same way

what is called the art of bone-setting, as you no doubt know, is associated with certain names and localities; known chiefly in provincial districts, where also flourish the makers of the nostrums now in question. The liquid solvents—for they usually take that form—are sold in this country under the name of "constitution water," or some similar term; and as a matter of course they are also guaranteed to be useful in all forms of urinary disease.

Peculiar circumstances have given me large opportunities of observing and examining these agents. I have met with them here and in different parts of France. I well remember an old Frenchwoman and her son journeying on foot from the South of France to Brussels, many years ago, laden with a basket of heavy bottles filled with the family nostrum for presentation to a royal patient there. (The first King Leopold of Belgium, who suffered severely from calculus, and whose case excited much interest at the time.) I may add that her devotion was substantially rewarded. Such unsolicited contributions—either material, as in this case, or by way of suggestion of every conceivable kind—flowed in then from every part of Europe; and such is always the case in similar circumstances.

Let me say that it has been my lot to receive numerous communications on this subject from known and unknown correspondents, urging on me the value of the recipes which belong to the writers. I shall select two examples, which widely differ, for mention here, each possessing interest of its own kind. One was from a French gentleman, who gives me his name, and offers an infallible cure for the stone, which of course he does not describe, but consents to communicate it for the moderate sum of a million of francs (£40,000 sterling); and I do not hesitate to say it would be well worth the cost if it could accomplish the wonderful results alleged to be within its power. The other communication was sent me by an English laborer in Bedfordshire, who wishes me to know what cured his friend some time ago in the neighboring parish. He freely presents me with the formula, and it is a fair specimen of a good country recipe for the purpose—for I have seen many such—and it has some interest for us, as we shall find hereafter. I could not help writing my thanks to this man in reply, and was at some trouble to explain why his remedy

might be good in some cases, and why it might be prejudicial in others. Here it is in his own words: "Get a peck of wood-ashes, and pour on them a gallon of boiling water; let it stand twenty-four hours: then strain it off as clear as possible, and take a wineglassful every morning, fasting." This is a large dose of carbonate of potash: our old friend, the alkali, you see, always recurring. I had the curiosity to determine the quantity. A lye of wood-ashes thus made from pine-wood furnishes a solution of fifty grains of the carbonate to the ounce, so that the quantity taken at once was at least a drachm and a half or two drachms. The other soluble constituents of the lye are sulphate and silicate of potash and chloride of potassium.

Now, as to the more pretentious compounds which are sold in this country as solvents, I have submitted the chief to careful chemical analysis, and I intend to present you with the result. Not that I had any doubt as to what their general characters and composition were, nor of the fact that they were all nearly alike in their composition. But I wish you to have an exact statement founded on analysis. A recent examination of a well-known and typical one sold as "constitution water," and in some repute in this country, shows it to consist of a simple undisguised solution of bicarbonate of potash in water. Two bottles are placed before you, and are at your service for analysis if you like to make it. You see that they are ordinary wine-bottles, the old "wine-quart;" each contains about an ounce of bicarbonate of potash and fifteen grains of chloride of sodium—with a few sulphates in minute quantity, possibly due to the spring water of which evidently the solution is made. Half the bottle, which is equivalent to four drachms, is directed to be taken daily. The price at which this "constitution water" is sold is three shillings and sixpence the bottle!

And here let us make a rapid survey of the long and curious history of man's painful, slow, and somewhat clumsy efforts to rid himself by medicine of his terrible enemy, the stone. Observe that the agents have always been alkaline. At first, and chiefly, the alkaline earth, lime: you mark it as the agent in the calcined snail-shells of Pliny and the egg-shells of Avicenna, which do but reappear in that expensive prescription of Mrs. Stephens in 1739; but in Avicenna's time it was combined with potash, the representative alkali of the

vegetable kingdom, as you see in the quantity of burned plants which enter into the composition; and Mrs. Stephens, probably without knowing it, employed potash and soda also, by means of the very important addition of soap, calcined weeds and seeds to the egg-shells. After this lime-water and soap came into fashion, giving another combination of the three alkaline agents named. And the popular remedy of to-day before you, sold at so high a price to the purchaser, and of which a large quantity is ordered to be taken daily for three months, as the minimum dose and time, is, as you have just seen, a simple solution of bicarbonate of potash in water; and the cost of it to the seller is actually less than that of the bottle and the cork which enclose it! Our country laborer's nostrum is nearly if not quite as good in form, has precisely the same solvent power, and is almost absolutely without cost.

Then the alkali again appears in a group of natural mineral springs, of which a somewhat popular remedy—namely, Vichy water—is the type. These have been and still are largely employed by patients with urinary maladies, and have been vaunted for their solvent powers on the ground that they consist mainly of a strong solution of carbonate of soda, the alkali of the mineral kingdom, as potash is of the vegetable

We are now in a position to arrive at the following conclusion, the only one possible—viz. that all the empirical and would-be secret medicines employed from time immemorial to the present day are solutions of either lime, soda, or potash, alone or combined. All the plants, after combustion, furnish alike only one and the same active agent—viz. potash; all shells, whether of eggs or of marine and land animals, furnish alike only one and the same active agent—viz. lime.

Lastly, the medicinal remedies employed by the faculty everywhere, at the present day, are hydrate of potash, in the form of liquor potassæ, the bicarbonate, the citrate, the acetate, and the tartrate of potash. After them, and less generally employed, are soda and lithia in different forms.

Now, before entering on any consideration of the applicability of all these agents as solvents, from a scientific and not from an empirical point of view, it is necessary to examine briefly the substances they are destined to act upon—namely, the stones in the kidney or the bladder which it is desired to dissolve. And the first fact that must strike you at the out-

set is, that these calculi are of different kinds; some having characters diametrically opposite to those of another kind. And the question naturally arises, Is it possible that one form of remedy—namely, the alkaline agent—can be adapted to dissolve calculi whose composition is so varied?

I shall remind you of those general terms which I used in a recent lecture on that subject to classify the varieties of urinary calculi. Three-fifths of all the calculi met with among adults of all ages are composed of uric acid and the urates; nearly two-fifths are chiefly phosphatic, many of which are "mixed"—that is, contain at least two different constituents; and about 3 or 4 per cent. are oxalate of lime. Cystine is too rare to be admitted to our reckoning. Three-fifths at least, then, are the products of a urine abounding in acid, of which excess they are the expression. The remaining two-fifths are the product of urine generally alkaline, mostly ammoniacal, of which condition they are the result. The urates, the oxalates, and a very few of the phosphates, are formed in the kidney, and are the product of certain constitutional derangements; the greater part of the phosphatic material, whether in mixed or in phosphatic stones, is produced solely in the bladder, and is the product, not of a constitutional state, but of local disease there. Now, uric acid we know, by experiments conducted out of the body, to be soluble in alkaline solutions, but some of these have a more energetic solvent action than others; and the resulting salts vary in solubility. Thus, urate of lime is a rather soluble salt. Urate of soda is less so, and in this form enters into the composition of some calculi. Urate of potash is more soluble than either of them. Potash, the alkali of the vegetable kingdom, appears to be the most powerful solvent (although lithia may be nearly equal) that can be employed on a uric-acid calculus, among those materials which are capable of being taken internally for a long period of time with comparative impunity. These facts, then, indicate it as the most desirable agent to employ under certain conditions, hereafter to be described, and as such it has long been regarded. More than thirty years ago I called attention to its pre-eminence for this purpose, stating that the "citrates and carbonates of potash are more potent and certain than Vichy water" for the treatment of "uric acid in the form of gravel," and that they should be given largely diluted, pure

water itself being one of the best solvents.[6] I may add, that I have always declined to prescribe Vichy water for any urinary affection, and on the ground of its inferiority to the potash solutions. I think the citrate of potash may be fairly said to be the salt which of all others offers the best chance of success; and this is now the opinion of all who have examined the subject. If, however, it exerts too much diuretic action, as in some cases it seems to do, the next best may be employed—namely, the bicarbonate, or the liquor potassæ.

A question of great interest comes before us here. Has citrate of potash been fairly tried on stone in the bladder by a competent observer? I am happy in being able to answer this question in the affirmative. A well-known and accomplished physician, Sir William Roberts, of Manchester, formerly a distinguished pupil of this school, has made carefully conducted experiments on calculi in and out of the bladder with certain results. I give you the following brief analysis of them:

Sir William Roberts finds carbonate of potash to be the most powerful solvent; better than soda, much better than lithia. The solution must not be too strong, otherwise an alkaline biurate coats the calculus and solution is checked. The best salts to administer by mouth are the citrate and the acetate, these, as you know, becoming carbonates in the urine. The adult dose should be forty or fifty grains in three or four ounces of water every three hours—equalling six drachms daily. The urine thus rendered alkaline may become cloudy from amorphous phosphates, but this state does not hinder solution, provided the urine is not also ammoniacal; but if it becomes so, it is most important to bear in mind that all solvent action then absolutely ceases. Hence it is useless to attempt the solution of a uric-acid stone unless the urine is naturally acid. If the urine is alkaline before commencement it is certainly ammoniacal, and no solvent will act, as mixed phosphates are deposited on the surface of the stone. He admits that it is quite useless to attempt the solution of a large calculus of any kind, or of an oxalate of lime calculus: and that nothing can be done with a phosphatic calculus except by the process of injecting into the bladder. Lastly, he states, alkaline injections of the bladder for uric-acid calculus are without efficacy. To resume: the following conditions are essential to success: certainty that the stone is of uric acid,

and that it is of small size; that the urine is acid, and never ammoniacal. These extremely favorable conditions existing, the most powerful solvent known—potash—offers a fair chance of diminishing its volume considerably after a trial of several weeks, so that the nucleus may perhaps be passed by the urethra; but at present Sir William Roberts is not able to report so complete a success.[7]

There, that is the best thing that modern science has yet done towards accomplishing the dissolution of the stone. Then you say, Have there been no results whatever from the empirical methods you have described? Have miserable calculous patients for two thousand years been swallowing to no purpose all the nauseous mixtures described, from the time of Pliny to Joanna Stephens, and onwards through Chittick, with his locked cans, to the nostrum dealers of our own time? I wish to give you a fair and distinct answer to that question, and will do so as far as it is in my power.

I reply, first, that no trustworthy evidence has yet been produced, that the complete solution of a stone in the bladder has been effected by any alkaline agent whatever. I cannot find that any patient, certified to have stone after sounding by a competent surgeon, has, after a course of any solvent, been again sounded, or submitted to autopsy, and demonstrated to be free from stone. Less evidence than this is valueless. That the alkaline solutions often greatly palliate severe symptoms in some cases and enable some patients, but by no means all, to continue in comparative comfort for a considerable time without extraction by any method, I have long been perfectly satisfied. I have seen a remarkable example or two of their influence among those aged and very infirm persons whom it would be very dangerous to submit at any rate to lateral lithotomy, and whose calculi are not within the limits of lithotrity. Such have sometimes been enabled to spend the remainder of their lives with little or no suffering, provided that they were also enabled to maintain a condition of repose and freedom from movement. More commonly, however, the freedom from pain which alkaline agents produce is temporary only; and in some cases the effect of them is to produce considerable aggravation of the symptoms. This was often observed during the "soap and lime-water" period. But it is not the question now to estimate what degree of palliative

influence is exerted by alkalies, but whether they can effect a complete solution of the stone. Morand's cases, already referred to, of which twenty-two were sounded before taking the medicine, did not supply a single proved example of success. Among the alleged triumphs of the lime and potash treatment, many patients were examined after death and found to have stones, often numerous and large, still in the bladder. (Dr. James Parsons reports twelve post-mortems of Mrs. Stephens's patients, who, dying, were found in that condition.)[8] But what is more to the point is, that the four persons who were examined by the trustees appointed by the Government to determine the merits of Mrs. Stephens's remedies, and certified to be cured, died, each one of them with stone in the bladder, where it was found by post-mortem examination! (The names of these patients were Gardiner, Appleton, Norris, and Brighty.)[9]

The case of Horace Walpole in the last century is well known; it was written by himself for the Royal Society. He commenced—being nearly seventy years of age—to take from half an ounce to an ounce of Alicant soap and three pints of lime-water daily for many months at a time, and with short intervals, up to the period of his death at seventy-eight. He experienced great relief after taking them for a year or so, and ultimately believed himself to be cured. At his death three smallish calculi were found in his bladder. The case naturally attracted much interest at the time, and is one of the most carefully observed on record.

But there is another curious fact in connection with this matter, namely, that the great majority of the patients who took these medicines then, and of those who take such now, are not the subjects of stone at all. They have painful symptoms which they are pleased to consider evidence of stone in the bladder, and they take large doses of alkali—notoriously one of the best remedies for painful micturition from any cause—and obtain relief. They then tell their neighbors, and often certify in print, that they "have been cured of that dangerous malady the stone." These are the great cures which the nostrum-mongers rely upon. For what happens to those few of their clients who really have stone? Two things may happen: first, the stone, if uric acid, becomes coated, as Sir William Roberts describes, with the biurate, which either adheres or

comes away in scales; or, secondly, the urine will become ammoniacal; and thus in either case no dissolution whatever can occur. During the time, however, large quantities of white sediment composed of the earthy phosphates or even of shell-like fragments of the biurate, to say nothing of the white granular deposit of the mixed phosphates, come away; all which the poor patient is led to believe to be the débris of his stone and the proof of the efficacy of the solvent process! This fact exists in the great majority of cases, and is always relied upon by the nostrum vendor as an infallible sign of the value of the agent! Meantime the stone is acquiring, not slowly, fresh layers of deposit, and is becoming almost certainly larger. Such must often be the inevitable result where the medicines are empirically given—that is, without reference to the nature of the stone and the condition of the urine, and where the procedure cannot be watched and regulated on the principles laid down above. But, say you, this is a mere *à priori* statement, and looks very plausible, no doubt; but how do you know that this happens? I will give you two instances which will suffice, and can give more, if required. Several years ago a man came to me from Yorkshire, who, having had symptoms of stone for a considerable time, was advised to take some well-known solvent for his malady. Accordingly he did so, and you will agree with me probably that he took enough to insure it a fair trial, for he swallowed twenty-five pounds' worth of that very constitution water a sample of which you see before you on the table. He was relieved, but his life was necessarily an active one, and he had not the means of repose and the luxurious surroundings which Horace Walpole had, and his stone symptoms ultimately got worse. At last he came to me, and I crushed for him a large mixed calculus, the greater portion of which was phosphatic. Had he come to me before, it would have been a smaller one. The case did well, and the man lives at this day to tell the tale, and, if necessary, he is ready to tell it again. Since that time I have seen more painful illustrations of the mischief done by this nostrum; one case especially, within the last few months, in which death was due to a large phosphatic stone produced through the action of the alkali taken. It was formed upon a small uric-acid calculus, which could have been crushed with ease and safety in three minutes when I first detected it, and recommended that course. But

the patient preferred the "solvent," and in about two years filled his bladder with a phosphatic mass which cost him his life.

Now, mind, I do not venture to say that a calculus has never been dissolved, or that it is impossible to dissolve a small uric-acid calculus by alkaline agents taken internally. I will go further, and express my belief that, given abundance of time and careful supervision, it may perhaps be possible. Nay, I will do more: the first case of such a kind that comes into the hospital, the patient consenting, I shall be pleased to submit him for the sake of experiment to the process, and to give it a fair trial. But this I say with certainty, that there is no evidence whatever that one case in a thousand of those who have swallowed solvents for the stone has been cured of it, during all past experience down to this day. No man who deliberately takes solvents for even a small calculus, the characters of which have not been carefully determined, can reckon on any better chance than this—viz. that it is a hundred to one against their success, and that it is more than probable that his stone will grow bigger during the process. And if the stone be large, the solution is impossible.

What is the value of the treatment in question? It is impossible to say more than that it may be valuable, not for stone in the bladder, but for that earlier stage of the same malady—stone in the kidney. That is the period of its history in which to attack the stone by solvents. When small uric-acid calculi are passing periodically or occasionally, much may be done: first, and chiefly, by preventive treatment, on principles I have already explained to you in the preceding lectures devoted to that subject; and if that be insufficient alone, secondly, by combining perhaps therewith some alkaline treatment. Granted proper constitutional treatment of the complaint in the early stage, there ought rarely to be much trouble with stone in the bladder. I confidently anticipate a future in which any severe operation for stone will be rare. Uric-acid stones only, as you know, are amenable to the process by solution; but happily, they form the very large majority of renal calculi.

I must say a few words about agents to be used locally in the bladder for the solution of phosphatic formations which are not dissolved, but rather increased, by the internal remedies

already described. You know that there are many patients, chiefly those who are unable to empty the bladder except by catheter, who are very prone to form calculous matter of the mixed phosphates, and this sometimes at a rapid rate. For these persons various solutions injected into the bladder may be valuable. The patient may be taught to administer them himself; numbers have been taught in my wards. Once or twice a day, after withdrawing all the urine by catheter, he applies to the end of it a four-ounce bottle, with a stopcock, containing a solution of acetate of lead, about one-third or one-half a grain to the ounce of distilled water together with some acetic acid. He throws in half the contents, and allows it to issue, carrying out with it some small débris perhaps. He next injects the second half, and allows it to remain there. This does something to prevent the formation of phosphatic calculus, or, at all events, of the aggregation of its elements in the bladder. I have no intention to describe now at length the methods of mechanically dissolving or washing out these matters, when the above simple means are unsuccessful. More complete details in reference to this subject will be found in its proper place.

I must not omit to name the agency of electricity, which has also been locally employed, both for uric-acid and for phosphatic stones. Prévost and Dumas (1823) attempted direct solution of a stone in the bladder by the galvanic current, a plan which was more fully developed here by Dr. Bence Jones (1852). The amount of instrumental manipulation, however, necessary to bring the wires into contact with the stone and to maintain them there during the period necessary for its solution is considerably greater than that required to crush the stone by the modern method of lithotrity, and must therefore be regarded at present as inapplicable.

And now comes the inevitable final conclusion—inevitable because true. It has been shown that there is no chance for the dissolution of any but a small stone, and this provided only that it exists in the most favorable circumstances; and lastly, that in order to accomplish the task a considerable period of time must be devoted to the process.

For such a stone, gentlemen, but one brief sitting by lithotrity is necessary. No operation in the whole range of surgery is more certainly safe, rapid, and successful; and no

other proceeding ought to be resorted to or even considered. I repeat the statement, that such a case I have never lost in the whole course of my experience. Nevertheless, a patient sometimes desires to be heard in relation to the course proposed, although he may be absolutely ignorant of the matter. He claims the right to exercise a choice, although he may not always manifest his wisdom in doing so. In these circumstances it becomes our duty to help him to form a just estimate of the relative merits of both methods; what these are I have thus endeavored impartially to set before you.

Bibliography.

1. Avicenna, lib. iii. fen. xviii. trac. i. c. xix.—2. "Elem. Chimiæ," 1732, ii. 73.—3. Riverius, "Praxis Medica," Lugd. 1657, p. 381.—4. "Gentleman's Magazine," June, 1739, ix. 298.—5. "Annales de Chimie," Paris.—6. "The Lancet," 1854, i. 439.—7. "Practical Treatise on Urinary and Renal Diseases," 4th ed., 1885.—8. A Description, etc, London, 1742.—9. Alston's "Lectures on the Materia Medica," i. 268. London, 1773.

SPRAINS;

Their Consequences and Treatment.

BY

C. W. MANSELL MOULLIN,

M.A., M.D. Oxon., F.R.C.S. Eng.

Assistant Surgeon and Senior Demonstrator of Anatomy at the London Hospital; formerly Radcliffe Traveling Fellow and Fellow of Pembroke College, Oxford.

SPRAINS AND THEIR CONSEQUENCES.

INTRODUCTION.

It has been my endeavor in the following pages to confine myself as closely as possible to the commoner forms of sprains, and to those after consequences which may be regarded as directly and immediately dependent on them. Of those which follow more remotely there is no end, and the briefest description would lead me far beyond the limits at my disposal. It has been said, and not untruly, that in all probability half the crippled limbs and stiffened joints that are met with every day, date their starting point from the occurrence of some apparently trivial accident of this description.

The question of treatment has been dealt with at some length; and if I have seemed to advocate the adoption of more active measures than those generally employed, especially in the case of long standing inability, it is only that I am firmly convinced of their efficacy and safety when properly carried out.

Few injuries are treated with so little consideration as sprains. It is impossible to overlook wounds, owing to the bleeding and pain that accompany them. Fractures, it is understood, require rest and care; but sprains, in which the tissues are torn to such a degree that the damage is far more serious than in many fractures, merely because they are so common, are considered of little or no consequence.

It counts for nothing that the part injured is one of the most complicated structures in the body, and particularly liable to inflammation from the constant use to which it is subjected. The construction of a bone is comparatively simple, and its function is merely the passive duty of support. A

joint, on the other hand, is exceedingly complex, and must not only be as strong for support as the bones between which it lies, but must, in addition, be capable of executing rapid and often extensive movements. Two, three, or even more bones may enter into its construction; each of them where it forms part of the joint is faced with cartilage; around them is a protecting capsule of fibrous tissue, lined with a delicate secreting membrane; ligaments of different kinds hold the bones together; muscles of various size and strength move them one on the other; there is a very large supply of blood-vessels and nerves; and even the tissues round are so adjusted to the surfaces that with every change in position they fill up the constantly-varying spaces round and between the bones. Yet a fracture is regarded as very serious; a sprained joint as quite a trivial matter.

In the one the injury is simple and definite in its character; one broken bone does not differ very materially in this respect from another; in the other there is no limit to the variety of hurt sustained, or to the complications that follow. The ligaments may be torn across, or wrenched off the bone; the muscles may be lacerated; the tendons displaced bodily from their grooves; the discs of cartilage which are present in some joints between the bones, forced out from their position; the joint cavity filled with blood, and so much more extravasated into the tissues that the discoloration may reach from the ankle to the knee; in short, the tissues may be torn and bruised as extensively as in a dislocation. In many cases the injury is to all intents and purposes the same; the sole difference is that the bones which were wrenched apart at the time of the accident resume their normal relation to each other in the one, while in the other they either remain fixed, or slip a little further aside. Vidal de Cassis appreciated this when he spoke of sprains as temporary dislocations.

There is no end to the variety of the injuries that are classed together under this name. It is almost an impossibility for two sprains to be exactly alike. Joints differ from each other as widely as they can, both in structure and action; different kinds of tissue enter into their formation, and serve as many separate purposes; the violence that causes the accident is different in every case, both in its force and direction; and the position of the limb at the moment can rarely be the

same. Some joints are much more liable to injury than others, those especially in the lower limb; and the ankle more than the hip or knee. In some the stress falls on the ligaments; in others, as in the shoulder, on the muscles; very often both suffer together, though in varying proportion; or without the joint itself being injured, the muscles and tendons may be strained, and give rise to stiffness or weakness that lasts for years.

Other considerations also step in and help to make the variety greater. No two persons ever resemble each other exactly; even if this were possible in the earliest years of life, age, habits, occupation, mental temperament, bodily constitution, and many other things, induce such modifications that the slightest difference must at length become immense. Repair is not carried on with the same degree of energy in all; in some complications occur much more easily than they do in others; inflammation breaks out more readily, or other troubles make their appearance; so that, even if by some strange chance the injuries were identically the same in any two cases, it is impossible for them to continue so for any length of time. In this respect peculiarities of constitution are of great significance; in the majority of instances the ultimate result, whether the joint recovers within a reasonable period, or remains cold, stiff, and untrustworthy for years, depends much more on them, and on the method of treatment adopted, than on the mere fact of a ligament having been torn or only stretched.

This, however, is not the only reason why sprains do not merit the neglect with which they are so often treated. Imperfect recovery in the case of a broken bone is quite exceptional. Failure of union does sometimes, but very rarely, occur. It is more common for the position of the broken ends to be faulty, so that there is some deformity, or loss of power; but even when this does happen the after-trouble or inconvenience is only of a temporary character, and at the end of a few weeks or months, at the most, the limb is as strong and firm as ever. Such a thing as yielding, weakness, or continued pain at the seat of fracture is almost unknown, unless there is some exceptional condition of things present. It is not so with sprains. An amount of the thickening round the seat of injury, so slight as altogether to escape notice in the case of a fracture, is quite enough to disable a joint.

It is true that a large number of sprained joints get well of themselves, or under ordinary domestic treatment, a few, it must be admitted, in spite of it; but even in the young and healthy, it is not unusual to find the action of the joint seriously impaired. There may be merely a general sense of weakness and insecurity, a feeling that it is not to be trusted as it was before; or the least attempt at movement may be attended with intolerable suffering. There may be no very visible or definite alteration, or every tissue of which the joint is composed may be more or less disorganized. The skin may be exquisitely tender; the subcutaneous tissues swollen and distended, so that the natural outline cannot even be recognized; the muscles may waste away; the tendons become glued to their sheaths, and the interior of the joint be damaged to such an extent that, even if everything else were restored, it would be impossible for the bone to work evenly or smoothly on the other.

Results of this kind, happily, may nearly always be prevented. It is true that in some people the power of repair is much more feeble than it is in others; and, no doubt, under some conditions, such as advancing age, joints are especially prone to stiffness and other troubles; but taking them as a whole, few kinds of accidents are more amenable to treatment than sprains, if only two conditions are observed: one, that it is commenced sufficiently early; the other, that it is carried out thoroughly and efficiently, not in a perfunctory manner.

Afterwards, if the time immediately after the accident has been allowed to pass by, and the joint is stiff, and recovery imperfect, a great deal may still be done; but as a rule, the longer the delay the more remote the prospect of perfect restoration. The sudden and startling cures that are so often heard of are really few and far between. It must always be remembered that in surgery, as in most other things, successes are trumpeted abroad, and always quoted as an encouragement, while failures are either never heard of, or quite unconsciously are forgotten. Much more often recovery is slow and tedious, requiring care and much patience, with days in which improvement is well marked, interspersed among a much larger number on which either no change at all is apparent, or possibly even the pain and stiffness seem actually worse.

CHAPTER I.

THE ANATOMY OF JOINTS.

THERE is no need in a work of this kind to enter into a detailed account of the structure of joints, or to describe minutely the different varieties. I shall only mention a few particulars to which it seems advisable to call attention, as the clinical symptoms that follow injuries do not always correspond with the structures as described in ordinary anatomical treatises.

A joint is the connecting link between two of the rigid parts of the skeleton. Both in the trunk and in the limbs the main support runs down the centre like an axis, and for the sake of mobility is divided into rigid and flexible segments. The latter are known as joints.

Yielding Joints.—Some are very simple. There is merely a tough layer, made up partly of fibrous tissue, and partly of cartilage, uniting the two bones, and allowing a limited amount of bending to take place between them in all directions. Bone and fibro-cartilage are developed from the same material; in one part lime salts are deposited, so that it becomes hard and dense; in another fibres make their appearance, and it is converted into ligamentous tissue, capable of bending with ease from side to side, but admirably adapted to resist longitudinal strain. The two are quite continuous, and shade off imperceptibly into each other. So slight, indeed, is the difference, that it not unfrequently happens, as a result of disease, or even of old age, that the whole becomes converted into bone, and the joint disappears as such.

Others are a little more complicated; but the changes that make their appearance during normal growth, or at certain special periods, show plainly that the difference between them and the more complex ones is only one of degree, and not one of kind. The ends of the bones, if carefully examined, are a little expanded, so as to form a wider surface for the attachment of the uniting disc; while the sides are cut away to lessen

the weight and to economize material. At the same time the softer intermediate part becomes modified. Owing to the varied character of the strains that fall on its sides and centre, they become different in texture and in power of resistance. The centre, where, whatever the direction in which one bone is bent on the other, there must always be pressure with but little tendency to separation, remains cellular, or becomes so soft and yielding that in some cases it is almost fluid. At the circumference, where in every strain there is compression on the concave side and tension on the convex, the connecting medium gradually becomes more and more fibrous, until by degrees the originally uniform layer of fibro-cartilage is resolved into a central cavity surrounded by a fibrous capsule and separated from the surfaces of the bones by a layer of cartilage which undergoes no alteration.

Such are the joints in the backbone between the bodies of the vertebræ, though in them, at least in man, the change rarely progresses so far. The union is exceedingly strong; the amount of movement allowed at each very limited, though it may take place in any direction; and the aggregate result of a number close together is very considerable.

They are very rarely sprained; their strength, their position close together, so that any stress falling on one is distributed over a large number, and the limited range of movement, prove their safeguard. If the violence is so extreme that something must give way, they either tear across or separate from the bone on one side. Then the injury is to all intents and purposes a fracture, and like fractures is repaired by the deposition of bony material, so that the joint is lost.

Movable Joints.—It is only a step from joints such as these to those in which there is a well-defined central space, enclosed in a fibrous capsule, and lined with a delicate secreting membrane. The development of the various parts is carried further and further, until they differ from each other widely in appearance; but the degree of relationship between them is as near as ever it was; and they are as much connected together, and as closely bound up with each other, as they were before the change. The difference is only one of degree, not one of kind. They become varied in outward appearance and physical properties, because of the different services they have to perform; but they never lose their mutual sympathy or con-

nection. It is impossible for one part of a joint to be injured, or to suffer in any way, without influencing the rest. Joints are not built up, like machinery, of different and separate parts, any one of which can be injured and replaced without interfering with the others; they are living organs, which cannot be healthy if the smallest part fails in its duty.

The Bones.—In the limbs and the more movable joints the modifications are especially great. First, the bones, which are the chief supporting structures, become more highly specialized. Instead of retaining the same uniform character the ends are altered in one direction, the middle in another. The shaft becomes hollowed out and assumes a cylindrical form, the shape well known to mechanicians as the one best calculated to withstand vertical pressure and lateral strain with the minimum expenditure of material. Here and there the compact walls are strengthened by outlying ridges, so that the cross section in some is almost prismatic. The ends, on the other hand, become wide and expanded, to increase the extent of surface that enters into the formation of the joint; often they are still further enlarged by processes jutting out to afford greater strength and security for the ligaments that hold them together, and more advantageous leverage for the muscles that move them. At the same time the internal structure loses its uniform arrangement. Where the range of movement is limited and equal in all directions, the interlacing network of bony spicules, of which the sponge-like interior is formed, shows no well-defined differences either in density or arrangement. The outer layer is merely a little more compact and smooth on the surface than the rest. In the more highly developed joints, no matter in what direction the bones are sawn, the dense tissue that forms the outer layer, and the open-work interlacing bars inside, are always so arranged in arches and curves as to diffuse as far as possible over the whole the pressure that falls on any one spot, and to secure the greatest amount of strength and elasticity with the least weight and the smallest expenditure of material.

Then the surfaces in contact with the opposite bone become varied in direction and outline in order to correspond to the movements. The more active and vigorous these are, the more changed and uneven they become. In the simplest joint they are flat, and face each other directly, only allowing a

certain amount of gliding between them. In others—the shoulder and hip, for example—the extremity of one bone is hollowed out into a cup into which the other fits, more or less accurately, according to the degree of support required. In the lower limb, where the need of this is much greater than in the upper, the rounded extremity of the bone forms more than half a sphere, and is so tightly embraced by the sides of the cup, that, even when everything that holds the bones together has been divided, it requires very considerable strength to pull the two apart. In the shoulder, on the other hand, the cavity is shallow, the head of the bone large in comparison, and the range of movement increased thereby at the expense of the security. In a third class, the ends are so modified with regard to each other, that movement can only take place in one plane as on a hinge. In the elbow, for example, the bone is rounded from before backwards, and fits into a corresponding depression on the other, rotating in it on an axis that runs from side to side. In the ankle there are stout projecting processes, one on either side, so that movement is strictly limited to one direction, and lateral bending is impossible.

When more complicated movements are required, the modifications become greater still. In one instance a ligamentous ring attached at one side is thrown round the neck of a bone, so that it can turn securely in it on its own axis. In another, discs of fibro-cartilage are interposed between the bony surfaces to deepen the sockets and lessen the impact of shocks; or, as in the case of the wrist and foot, a number of small bones are so adjusted to each other that the pressure falling on any one of them is diffused and distributed over all the rest.

The Fibrous Tissue.—These changes are not confined to the bones; in the more movable joints the ligaments become modified quite as much. As already mentioned, in the simplest the fibrous tissue that joins the bones together passes directly from the surface of one to a corresponding point on the other. Where the range of motion is a little more extensive, the part round the circumference becomes more fibrous, the interior softer and more cellular. In those which admit a wide extent of movement the change is carried further still. The soft central space becomes a well-defined cavity; and the fibrous tissue round forms a firm ligamentous capsule, enclosing it, and tying the two bones together.

The Capsule.—Simultaneously with this the point to which the capsule is attached undergoes an alteration. Freedom of movement is easily gained by increasing the length of the fibres; but at the same time stability and security are lost, unless, as in the case of the shoulder, the surrounding muscles replace the ligaments in checking and controlling the action. Accordingly, in all cases in which the range of movement exceeds a very small angle, the fibres no longer pass from surface to surface, or even from margin to margin, but are shifted further back on to the sides of the bones, so that the ends of these are enclosed by the capsule and lie inside the joint. By this arrangement one bone is enabled to glide on the other when any stress falls on it, and freedom of movement is gained without the sacrifice of strength. There are few joints in the body admitting of much angular movement in which one joint does not glide to some extent on the other.

The Ligaments.—The strength of the fibrous capsule becomes modified at the same time. Where the amount of movement is but little, and is equal in all directions, there is a uniform and even layer, extending all round the joint from one bone to the other. When the structure of the bones allows bending in one plane only, as in true hinge-joints, the side portions springing from the ends of the axis of motion are more highly developed than the rest. Each is attached to a point on the more fixed bone, and radiates from this in a fan-like way on to the other, so that the two are firmly braced together in all positions of the limb. At the back and front it is thin and loose, merely serving to protect the cavity of the joint. By steps such as this the capsule of a joint gradually becomes split up into four divisions, which appear to be so isolated and distinct from each other that they are often called anterior, posterior, and lateral ligaments. They are not, however, separate structures in any sense of the term. They are only subordinate parts of the same that have become differentiated from each other by the difference in the character of the work they are called on to perform.

In a ball and socket joint, which, so far as this is concerned, may be regarded as a kind of universal hinge, the capsule is modified in the same manner. In the hip, where unyielding support in front is required, that part is so strong that, even in dislocation, it very rarely gives way; behind, where there

is but little strain, it is comparatively thin and weak. In the shoulder, everything else is subordinated to accurate and rapid action in all directions. The capsule consequently is, with the exception of one part, so loose and long that it only becomes tense when the angle of movement is extreme; the muscles here take the place of the ligaments almost entirely, and not only execute but also control and restrain the movements of the arm with a precision that would be impossible if it were dependent on passive and unyielding fibrous tissue.

The Synovial Membrane.—The cavity of a joint always contains a certain amount of an exceedingly viscid fluid, known as synovia. The quantity is very variable even in the same joint, but in general there is merely sufficient to moisten the surfaces that are in contact with each other, so as to avoid friction as far as possible. It is secreted by a delicate structure known as the synovial membrane. This lines the interior of the fibrous capsule, and is prolonged into all the outlying pouches in connection with it, but does not extend, at least in the adult, over the layer of cartilage that covers the ends of the bones. Before birth an exceedingly delicate film of cells, without any fibres, may be found in this situation; but they are soon worn off, and do not reappear. Where this membrane is folded on itself, as, for example, at the attachment of the capsule to the bone, it is often thrown into folds, which, under some circumstances, are capable of assuming a very considerable size. The inner surface is smooth and polished; the other is continuous with the fibrous tissue of the ligaments, where they serve to enclose the joint; but between them, and in the intervals found here and there extending under muscles, it possesses a delicate wall of its own, formed of connective tissue, and connected to the structures round by a few loose and scattered fibres.

This synovial membrane is in general regarded as a separate and distinct structure, found in those joints only in which there is considerable freedom of movement. In others, it is stated that an imperfect cavity is sometimes developed, but that it is never lined by a true synovial sac. This view is incorrect; neither the method of development nor the changes that take place in disease lend it any support. In reality, the synovial membrane is nothing more than the lining of the cavity, which is developed as the amount of movement in-

creases; and under similar conditions, structures indistinguishable from synovial sacs may be developed in any part of the body.

In the centre of a joint the cells which fill up the space between the bones break down, become liquid, and dissolve away; round the circumference they persist. The outermost, as already mentioned, are converted into fibrous tissues, and form the ligaments, or the capsule, as the case may be; the inner ones, those that immediately line the cavity, form the synovial membrane. The cartilage on the ends of the bones is not covered with it, or it is at most covered with a single layer of cells, because of the relation it bears to the cavity, and because there is no fibrous tissue developed on its surface. In the intervals between the ligaments, where there is nothing to protect the cavity of the joint, it is a little stronger than elsewhere, and may be called a membrane; but it is not an isolated or distinct structure here any more than it is elsewhere. It is continuous on either side with the neighboring ligaments; where it comes into contact with the cartilage it shades off into it, so that it is impossible to say where one commences and the other ends; and its outer surface is part of the loose and delicate connective tissue that fills in all the irregularities round joints, extends under the muscles and tendons, and forms a layer under the skin.

Mutual Sympathy of all the Parts.—Joints are commonly regarded as composed of many different structures, all of them separate and distinct from each other, with different and independent functions. There are ligaments to hold the bones together; a synovial membrane to render the movements smooth; cartilages over the ends of the bones to lessen the impact of any shock; and round them, filling up all the interspaces, a quantity of loose and delicate connective tissue, containing the blood-vessels and nerves which supply the joint.

This view may serve for the purposes of ordinary descriptive anatomy; but it gives an altogether wrong impression of the nature of the injury sustained when a joint is sprained, and of the causes of the complications and after-troubles that follow with such frequency. The bones that form a joint, no matter how many there may be, or how great may be the varieties of their shape, are surrounded and held together by connective tissue, which is structurally continuous with them. It bridges

over the interval between them, fills up all the interstices left by the muscles and tendons, and forms an investment for these and every other structure near. One part, where there is much tension, becomes dense and unyielding, so that it is known as ligament; in another the cells undergo a process of liquefaction, and a cavity is formed; the limiting wall of this is differentiated into a synovial sac, and a membrane more or less distinct is developed from it. The different structures lose all external resemblance to each other. What they do not lose is their relationship from their common descent. Throughout the whole of life the closest sympathy persists between them, so that it is impossible for any one of them to suffer by itself. It follows as a natural consequence from this that sprains can never be the simple things they are usually considered, or be confined to the mere stretching or tearing of an isolated ligament. The immediate effect of an accident may fall upon the ligaments, or it may not; it can never be limited to them. The capsule of the joint is opened up, the cartilages bruised, the muscles torn, the tendon sheaths strained, the interior filled with blood, and so much more extravasated into the tissues round that the strain may extend the whole way up a limb, and may not disappear for six weeks. Very often, in spite of the popular belief, the ligaments are the part that suffer least: they certainly never suffer alone.

Even if by any chance they were the only structures hurt at the moment, it is impossible for the other tissues to remain unaffected during the changes attendant on their repair. A wheel or a band in a piece of machinery may be damaged and restored without interfering with the other parts. When a ligament is hurt a certain amount of blood escapes into the synovial sac and the spaces round; all the vessels dilate; the synovial folds become swollen; the joint is tender to the touch; the temperature of the part is raised; its movements are interfered with; even the external shape of the limb is altered. Nothing escapes; every structure round participates more or less.

The same is true of the later troubles that so frequently impair the freedom of movement in joints long after they have been sprained. The stiffness, for example, that is often laid to the credit of a contracted tendon, or shortened band, is never due to this alone; nor is the sense of insecurity dependent en-

tirely, or even to any extent, on the weakness of an injured ligament. It is only by taking a wider and more comprehensive view of the structure of joints, and by regarding them as organs of the body, wonderful in their complexity, that a true conception can be obtained of the nature of the damage they suffer in sprains, and of the method in which they should be treated, so as to avoid, as far as may be, the occurrence of permanent injury.

CHAPTER II.

CAUSE AND PREVENTION OF SPRAINS.

Without going so far as to say that sprained joints can be entirely prevented, there is no doubt that it is possible to avoid and guard against them to a very considerable degree. In some people they are particularly common; and so they are at certain times, and under certain conditions. Others escape in a manner that seems almost marvellous, and possess the power of using their joints in a fashion that would be impossible in the majority.

The Condition of the Muscles.—This depends mainly on the condition of the muscular system. The strength and security of the articulations are assured in proportion to the perfection of its development. Sprains never occur unless the muscles are either weakened and tired out by prolonged exertion, or are caught unawares by some sudden slip, before they can recover themselves. Astley Cooper said of dislocations that it was only possible for them to take place when the muscles were unprepared for resistance; otherwise the greatest force would hardly produce the effect. Without saying so much of sprains, there can be no question that such accidents rarely happen unless the muscles that safeguard the joints are taken by surprise. Ordinarily speaking, they are the result of a sudden twist, so rapid that recovery cannot take place in time, and naturally this is most likely to happen to those who have never accustomed their muscles to much exertion, or who, from fatigue, have lost that instinctive vigilance and power of recovery essential to the safety of a joint.

This, among others, is one reason why sprains, especially of the knee and ankle, are so common among women, and those men who, in their youth, were distinguished for athletic feats. In the former, the muscles are insufficiently exercised, so that they never attain the vigilance and instantaneous power of response necessary to prevent the consequences of a

careless step; in the latter, with advancing years and altered modes of life, the muscles fall out of training, without its being perceived, or perhaps sometimes without its being acknowledged. Then some unusual effort, especially a prolonged one, that in days gone by would have been accomplished easily, proves too much for their endurance under the altered conditions, and something gives way. Unhappily, when this has taken place once, the joint often remains, as it were, a weakened spot, and there is always the possibility of the same thing happening again and again, with greater ease each time.

The muscles are really part of the joint as much as the bones or the synovial membrane. It may be more convenient to describe them separately, but the function of a joint is movement, and in considering the way in which sprains interfere with this, the muscles that execute and direct it are as much concerned as the ligaments, which have only the passive duty of checking it when it is excessive. This is true of all joints, but especially of those in which the freedom of movement is greatest, and which on that account are the most exposed to strains and injuries of like character. As Morris has pointed out, the strength of any single joint, and its power of resisting injury, are inversely proportioned to its freedom of mobility.

In the more fixed joints, where there is only an indistinctly marked cavity in the centre of the fibro-cartilage, the muscles are short and broad, with much inelastic fibrous tissue in their composition, and often are so arranged with cross-running and interlacing fibres that while one bone is moving on the other it is held even more firmly in contact with it than when it is at rest. Where, on the other hand, the range of movement is extensive, the security of the joint is often dependent entirely on the muscles. In the shoulder, for example, there is a fibrous capsule surrounding the ends of the bones, and forming the apparent bond of union between them. But it is so loose, and has so little influence in controlling movements, that if the muscles are paralyzed the arm drops down for upwards of an inch. Here in particular, owing to the need of accuracy and delicacy, combined with strength and rapidity, the function of controlling the movements of the joint is assigned almost entirely to those structures which originate them. The muscles take the place of ligaments.

When this occurs their shape and arrangement are modified. They become divided, roughly speaking, into two sets. Some are short and broad, and immediately surround the joint. These maintain the proper degree of pressure between the bones, and keep the action smooth. Others are much longer, and are attached to distant points by means of rounded tendons, which lie in grooves lined by a delicate sheath. On these depend the vigor and rapidity of the movements. They differ greatly in size and direction, but the connection that exists between them and the joint is no less intimate; the same nerve supplies them both. They are really but different parts of the same mechanism, so closely united together by the bond of common descent, and so associated with each other by the identical nature of the nerve supply, that it is not possible for one of them to be injured and the rest escape.

The same is true of the skin that covers them in and protects them. This, too, is supplied by the same nerve, and when the joint or the muscles is injured cannot help being affected at the same time. Illustrations of this are of common occurrence as the result of sprains. It has often been remarked that after prolonged and severe exertion the skin over the insertion of the muscles, and in certain spots over joints, becomes exquisitely tender from its sympathy with the parts beneath. It does not arise from any irritation or inflammation of the skin itself, for nothing has happened to affect it in any way. Yet the slightest touch gives rise to the feeling of actual pain. Firm pressure, on the other hand, relieves it, not, as is often said, because it is hysterical and imaginary, but because of the numbing effect of compression on the superficial cutaneous nerves. Plainly the skin, which is an exceedingly sensitive structure, is suffering in sympathy with the overworked organs it is intended to protect.

The Muscles as Ligaments.—The muscles, therefore, must be considered in a twofold relation to the joints. On the one hand they are the sole agents for executing movements; on the other, under all ordinary circumstances, they take the place usually assigned to ligaments, and act as the main safeguard. So long as the action is confined within moderate limits the ligaments are entirely unconcerned; they are merely passive bands of inelastic fibrous tissue, so loose as to have no restraining power until a certain angle is reached. Then they

suddenly become tight, and bring the movement to an abrupt conclusion. The muscles, on the other hand, are always tense, no matter what may be the position of the limb. No movement, not even the bending of a finger, is so simple that it can be carried out by the action of a single set; the opposing ones must always act with them, so that the movement may be even and steady, not disorderly at its commencement, or brought to a sudden standstill at its close. The firmness and security of the joints—except such as the knee—in all their positions are entirely due to the continuous steady contraction of opposing groups of muscles. They are the agents which prevent movement being carried too far, so that under ordinary conditions strains do not fall on rigid and inelastic ligaments. When from fatigue or carelessness this does happen, the ligament may be strong enough to resist, but more often—especially in the joints with free movement—it stretches or tears, and a sprain of greater or less severity is the result.

Under these conditions the muscles sometimes suffer, while the ligaments escape. The injury may be immediate, or not show itself until some time has elapsed They may be torn or bruised by the violence with which the bones are wrenched apart; or what is, perhaps, more common, hurt themselves by the sudden and almost involuntary attempt at recovery when a slip is threatened. If they escape at the moment they may suffer even more seriously at a later period from wasting, rigidity, or degeneration, so that in severe cases they become converted into dense unyielding bands. This, perhaps, is not a common occurrence when recovery is rapid, though it is by no means unknown; when it is delayed, they rarely fail to show that they have undergone some kind of change, and that they are not so perfect as they were before.

The Effects of Muscular Development.—Besides, however, acting as a safeguard and protection against accidents of this nature, the muscular system is of great importance in another way. The degree of perfection to which joints attain—and naturally they differ immensely in this respect in different individuals—is dependent entirely on the extent to which the muscular system is developed.

Where the muscles are poor and feeble the joints are poor and feeble too, and are easily sprained. The ends of the bones, instead of being angular, with sharply-cut and well-defined

edges, are smooth and rounded. The articular surfaces are faintly marked, so that they can glide on each other in irregular and unusual directions; the capsule is loose and yielding, and the ligaments, without the assistance of the muscles, are unable to withstand the least strain, or even to maintain the normal relation of the two bones. The action of the joint is uncertain and often painful, and the loss of power is proportionate. In case of any extra work the bony surfaces glide irregularly on each other, and move beyond their ordinary limit. The more often this takes place the more easy it is for it to happen again. Each time it is always carried a little farther than it was before, until at length, some day, one bony prominence is caught behind another over which it has slipped, or a tendon or disc of cartilage escapes from its bed, and the joint is locked. Pain and swelling rapidly follow. The patient may be able to restore things to their natural position at the first, but more often some assistance is required. The serious thing is that when this occurs, as it is wont to do more and more often, the joint never has time to recover its natural condition, and is left permanently damaged.

The principle that the more a part is used, within, of course, rational limits, the more perfect it becomes, has long been recognized in the case of bones. The skeleton of the male is very different from that of the female; the work is harder, and the bones become stronger. In the one they are solid, heavy, and exceedingly irregular, from the development of muscular ridges; in the other they are lighter altogether, and much more smooth and even. So with animals that have long been kept in confinement, the bones, contrasted with those of wild ones of the same species, scarcely admit of comparison, the difference is so great. It is the same with the muscles. As Humphry has pointed out, there is a difference almost of kind between the slender, compact frame and wiry, active muscular system of the thoroughbred, and the coarser, heavier, and more clumsy tissues of the cart-horse.

What is true of the shafts and muscular eminences of bones is equally true of their articular ends, and of the rough surfaces to which ligaments are attached. Joints are well formed and secure from injury, so far as shape can make them, in proportion to the amount of their use and the perfection of the muscular system.

Chronic Sprains.—Such a condition as the one I have described above may be almost called a state of chronic sprain. So long as it is slight it does not attract much attention. There are complaints of loss of power, and of twisting or giving way, but, as a rule, the deformity is not conspicuous, and especially as it is most common in children, it is put down to what is called growing pain, a name which has probably done as much harm as any other by the way in which it makes light of what often is the commencement of a serious disease. When it is more severe, or when during some unaccustomed effort the limb fails completely, the joint is generally said to be out. The pain is very severe; swelling soon makes its appearance, owing partly to the unnatural position of the bones, partly to the effusion round; and, owing to the insecurity of the joint, the loss of power is so great that the patient often believes himself paralyzed. It is serious, not on account of the tearing of the capsule or the injury to the parts around, but because the cause is such a persistent one, because the condition of things which has given rise to it is one that requires a long and systematic course of treatment before it can be rectified.

One of the earliest and most characteristic examples I have seen was in a young girl who was brought to me complaining of partial paralysis of the right arm, attended at times with attacks of severe pain. She was a tall, overgrown girl fourteen years of age, employed as a nursemaid, having to carry about a heavy child, and owing to this condition of her arm, which had been coming on gradually for the last three or four months, had lost her situation. She was not aware of having sustained any single severe injury to her shoulder; but stated, of her own accord, that long before it reached its present state it was continually giving way, or, as she expressed it, coming out of joint. On comparing the two sides together, it was evident that the muscles round the shoulder joint on the affected side were smaller than those on the other, though the difference was not equally marked in all. The movements were limited to a great extent by the pain they occasioned, and the general muscular strength was decidedly below normal. The cause was apparent at once; there was a large amount of thickening over the point of the shoulder round the joint, that is to say, between the collar-bone and the shoulder-blade; and

the bones were so loosely connected together that the end of one could easily be made to slip backward and forward over the end of the other. When the shoulder-blade was held in position by firm pressure from behind, the movements of the arm could be executed nearly as well as those of the opposite limb, and with nearly as much vigor, while the wasting diminished so much that evidently it was in the main apparent only. As soon as the pressure was taken off, the bone at once underwent considerable rotation, the upper border being so much displaced that a deep hollow made its appearance behind the collar-bone, which slid in such a direction that the two completely lost their normal relation to each other.

The fact that the wasting almost disappeared, and that the movements could be executed with ease as soon as the shoulder-blade was fixed, quite negatived the idea of paralysis. The slight amount of real wasting, affecting only a few of the muscles, could easily be accounted for by the inflammation of and round the joint; wasting much more extensive than this sometimes under these circumstances comes on within a week. There was no history of any accident sufficiently severe to suggest the idea of a dislocation with rupture of the ligaments; the onset of the mischief had been quite slow and gradual, though every now and then the pain—which had, as usual, been called growing pain—and the inconvenience had suddenly become worse. For the same reason it could hardly be termed a partial dislocation; the capsule was not torn, and the whole thing had come on slowly and imperceptibly, so that the patient could assign no date at all for its first commencement. The characteristic features were the weak muscular development, the imperfection in the shape of the articular ends, and the loose yielding condition of the ligaments. So long as no extra strain fell on the joint, the muscles, weak and feeble as they were, were sufficient to maintain the surfaces in contact; a little extra work, slowly and gradually in this case, tiring out the muscles, allowed the strain to fall on the ligaments, until, as ligaments always will when subjected to long-continued tension, they gradually stretched more and more, and became so loose that the end of one bone could slip backward and forward and ride over that of the other.

A similar case, differing, however, in the joint affected, that between the collar-bone and the breast-bone, and in the fact

that it was distinctly made worse by one rather severe strain, came under my notice almost the same day. The patient, who was also a girl, aged about 18 years, had suddenly felt a severe pain in this joint two days before as she was trying to lift a heavy weight, and, of course, had been told the joint "was out." At the first glance this did not seem unlikely, for the inner extremity of the collar-bone was much too prominent; but there was very little swelling or tenderness, and no bruising whatever. On further inquiry, too, it was elicited from the patient that for some months past the arm had felt very weak and unsteady in its movements. Examination of the opposite joint showed that it was nearly in the same condition, and, in fact, the bones on both sides were so loose that they could be pushed almost as far backward and forward as they could upward. Clearly, the ligaments were unusually lax, and two days before, when an unaccustomed strain fell on the right joint, it gave way, causing so much pain and inconvenience that the patient was compelled to seek advice.

These two cases are, perhaps, somewhat exaggerated examples, because in both the already loose condition of the ligaments had been intensified by severe strains; the same state, however, exists independently of these, and no joint in the body is exempt. The shoulder, as might be imagined from the description already given, is peculiarly prone to suffer. If the joint is poorly developed, or the muscles on which it depends for its security are lax and feeble, it can readily be made to assume abnormal positions. Sometimes this occurs with any movement, more often only with certain definite actions; in one case, a girl of 16, whom I watched for a long time, whenever in dressing of a morning she placed her hand on the back of her head in trying to arrange her hair, the upper end of the humerus slipped over the edge of its socket, and was caught there. At length she learned by a clever twisting action to bring it into its place again, and even gradually to avoid displacing it altogether.

In the elbow joint, from the shape of the bones, this accident can scarcely happen; but the same condition of things occurs. Examples may often be met with in which the forearm can, without any violence or pain, be bent back to an abnormal extent on the arm; the ligaments in front are so loose that they do not check the movement sufficiently, and the

bones so feebly developed that their projecting extremities do not come into contact with each other until the normal range is greatly exceeded.

In the case of the lower jaw it has long been known. Hamilton described it as occurring in his own person, and, naturally, with the greatest possible accuracy. He has noticed, also, the curious circumstance that this displacement, when it does occur, is much more common in the morning than at any other time of day. Particularly at breakfast the lower jaw, owing to the looseness of the ligaments that should restrict its action, is apt to become locked when the mouth is opened at all widely, and some manipulation is required to bring it back again.

Whether the same thing can occur in connection with the hip is, I should think, very doubtful. I have seen one patient who could at will dislocate her thigh-bone by a peculiar twisting of the limb; but in the absence of any history that could be relied on, and as her other joints gave no sign, which they almost certainly would have done in such an extreme case, I should imagine that probably this condition had existed from birth, by virtue of some congenital defect. In the knee minor degrees of it are quite common, not only allowing abnormal movements of the leg upon the thigh, but also giving too wide a range of action to the semi-lunar cartilages in the interior of the joint, whereby, perhaps, at length is brought about the beginning of a most serious affection known as internal derangement.

It is singular that this condition of the joints, which is very common in slighter degrees, and very striking in the exaggerated form I have described above, should have attracted so little attention. Sir Astley Cooper has described it in the case of one joint. Hamilton mentions it from his own personal experience in another. Malgaigne gives a vague account of something similar, but although he regards it, quite correctly, as the consequence of debility, and often determined to one particular joint by a local trouble, such as a sprain, he does not appear to recognize it as a general condition, affecting many joints at one and the same time; and he fails altogether to separate it from cases in which the capsule or ligament have been weakened, or stretched by inflammation, or by the passive accumulation of fluid in their interior. It is even more

strange that he fails to appreciate the fact that the ligaments, though undoubtedly concerned in the production of this condition, are in reality only passive agents, and not in any way the immediate cause. He states that it is due to an essential relaxation of the ligaments, though he fails to describe what this may be. In reality it is the muscular system that is at fault; for on this more than anything else depends the perfection of the joints, and the strength and power of resistance of the ligaments.

The secret of it all is to be found in the feebleness of the muscular system. In the first place the joints are weak, and the ligaments loose, because they have not been properly exercised. Then the muscles are not equal to any amount of work. When a little extra labor falls on them (and very little is needed in cases such as these) they soon become fatigued; the joints lose their support, and either the already feeble ligaments yield slowly and steadily, with a very considerable amount of pain, as ligaments always will yield when exposed to any severe strain; or else, owing to some sudden slip, the weight of the body falls on them before the muscles can save them, and some permanent injury is the result. It cannot be too clearly laid down that not only do the joints depend for their perfection on the degree of development of the muscles, but that, at any moment, the contraction of the muscles round a joint is as essential to its security as the ligaments, perhaps more so. If they yield, the ligaments will never hold for long.

Effects of Age on Joints.—One other feature in the construction of joints cannot be passed over in silence, as it helps to explain why sprains in some people are so liable to be followed by complications from which others are quite exempt. The joints are not alike at any two periods of life. It is acknowledged that they do not attain their highest stage of perfection until adult years are reached, but even after this their most important features undergo continual modifications. In infancy, adult life, and old age there are vast degrees of difference in their structure, due partly to the way in which they have been used, partly to the natural changes that take place in them as age advances, and partly to disease.

Leaving aside for the present this last consideration, the differences that exist between the joints at various periods of life are most striking. In the infant the surfaces and edges

of the cartilages are rounded and smooth, closely fitting together at the centre so as to leave between them merely a cleft, which widens a little, but very little, at the margin. The shape of the joint cavity is well defined, regular, and even. There are no outlying pouches or projecting fringes; everything is as simple as it can be. The fibrous capsule round presents the same features. It is, it is true, a little stronger in one part than it is in another, but there are no great accessory bands of dense unyielding ligament. All is soft and delicate in structure, shading off imperceptibly into the surrounding connective tissue, and what is, perhaps, the most important feature of all, exceedingly richly supplied with blood-vessels. In the adult these are confined almost entirely to two circles which surround the ends of the bones, where the capsule is attached, and send loops into the folds and fringes which abound there. In the child, and still more in the infant, not only are they larger and more numerous in proportion to the size of the parts, but they extend over the whole circumference, and are not limited to any single region. In consequence of this, when inflammation arises, no matter what may be the cause, its course is much more rapid, and the exudation of lymph infinitely more profuse. In children sprains are attended by an altogether disproportionate amount of swelling, and probably many of the complications that occur in them are due, not so much to inherited tendency as to the extraordinary richness of the blood supply, and the rapid and tumultuous character of the tissue changes that take place under such conditions.

All through life, not merely in youth, but even in old age, this undergoes continual change. The difference is not only one of size, but of structure, arrangement, and relation. The cartilage is replaced by bone, with the exception, as already mentioned, of the layer that directly lines the cavity. The edges become sharp and well defined, and the surfaces are no longer moulded accurately to each other. The capsule increases in strength and thickness. Where the strain is great the delicate connective tissue becomes dense and unyielding ligament; in other places it forms a close and even membrane round the central space. But these alterations, great as they are, are slight when compared with those of the synovial cavity and its delicate lining. This not only increases in size in

proportion to the growth of the joint, but becomes greatly changed in shape. Pouches are thrown out round the bony projections and into the weaker parts of the capsule until in outline it bears scarcely any resemblance to what it was at birth. Accessory spaces, known as bursæ, are developed wherever there is friction, under tendons, for example, or between bones and muscles. These differ in each individual both as regards shape and position. As age advances they become larger and larger, until at length they encroach to such an extent on the lining membrane of the joint cavity that the intervening partition gives way, and a communication between them is established by an opening which grows wider and wider each year.

While this is going on the surface of the lining membrane does not lag behind. It does not remain smooth and regular, merely folded on itself where it is reflected on the bones. Projections grow into the cavity from all sides. Some spring up from the spot where the capsule is attached to the bones, so that these are surrounded by a ring of fringing growths. Others project inward from the ridges and inequalities of the surface or the margins of the openings already mentioned. Some are short and smooth, others long and branched. In some the end expands into a rounded body containing cartilage corpuscles, while the neck grows thinner and thinner until it gives way and allows it to drop off. Many of them contain loops of vessels, especially when they grow from the region of the vascular circles; other are merely masses of fibrous tissue. There may be only a few scattered about, or the whole interior, especially if examined under water, may be covered with a dense shaggy coating under which it is no longer possible to recognize the polished regular surface met with in youth and childhood.

It is often difficult to tell how far these changes are the result of age, or to what extent they are the direct consequences of disease; the two so often go together hand in hand. The effect is that in no two persons are the joints ever alike; and the older they become, the more work and the harder the work they are called upon to do, the greater the changes and the wider the difference, until at length it is scarcely possible to find a resemblance except in the broad general features of construction.

CHAPTER III.

DIAGNOSIS.

It is not often that there is much difficulty in the diagnosis of a sprain, particularly if the joint is a superficial one, like the ankle or the knee. The nature of the accident, the sudden onset and peculiar character of the pain, the rapid swelling of the part, and the helplessness of the limb, are in general quite sufficient to convince the patient of the misfortune that has befallen him. But as, short of actual dislocation, nearly every kind of injury that can involve either a joint or the tissues in its immediate neighborhood, is called a sprain, this is scarcely sufficiently definite. In no other kind of accident do precision and exactness of diagnosis repay more thoroughly the pain and trouble of careful examination; nowhere is it more essential to form a definite conclusion as early as possible, not only of the kind of hurt sustained, but of its extent and degree. Even then it often happens that constitutional peculiarities, or other agencies less easily controlled, assert their influence, and seriously complicate the progress of the case.

Dislocations, fractures in the neighborhood of joints, and, in the case of children, separation of one of the growing ends of the bones, present the greatest amount of difficulty. In connection with this, there are one or two points which it is advisable to bear in mind. In the first place, in many joints, and particularly in those in which, like the elbow, complicated accidents are of common occurrence, an enormous amount of swelling sets in with such rapidity that all the prominences by which the relative position of the bones is ascertained are buried and lost in a very short time. Consequently, if the diagnosis is not made at once, immediately after the accident, it is necessary either to put the patient under an anæsthetic or to wait without a definite opinion for days, perhaps even for weeks, until the swelling subsides. The importance of this is so great that, especially at the present day, there ought to

be no hesitation about the administration of an anæsthetic. In the case of children, it is often impossible to form an opinion without; and even when it is, the risk is so exceedingly slight, the relief from pain so great, and the advantages of being able to examine the joint thoroughly without any muscular rigidity, and to apply the first dressings quietly and systematically, so immense, that they ought to be made use of where there is the least occasion. Nothing is more common than to meet with cases in which, from neglect of this precaution, because the first examination could not be thorough, joints have remained stiff or imperfect in their action throughout the greater part of life.

Further, if there is the slightest question as to the nature of the injury, whether it is a fracture involving a joint, or a sprain, the patient must always be given the benefit of the doubt, and the injury treated as if it were the more serious of the two, with this precaution, that passive motion must be resorted to, and the joint thoroughly worked at a much earlier period than it would be in the case of a simple uncomplicated fracture. It is probable that sprains of the ankle are very frequently confused with fractures of the small bone of the leg, and even with Pott's fracture without displacement of the parts; but as the immediate method of treatment adopted in these instances need not differ materially, no ill result follows, provided passive motion is adopted in time. Stiff joints, whether they are the result of fractures or of sprains, result most often from retaining the part immovable in a fixed apparatus for weeks together.

There is one further caution which it is necessary to observe, one that was originally suggested by Nélaton. It sometimes happens that, even when only a single joint is complained of, one or more of the others in the same limb has sustained some hurt, though of less severity. Consequently it is as well, when examining a sprained limb, always to commence by investigating the movements of the joints which the patient declares not to have been hurt; otherwise they may easily be overlooked, and some time later an aggravating degree of stiffness found that might easily have been avoided by the exercise of a little precaution. There is this further advantage, though it may not be worth much, that the patient, when the joint that really has been injured is taken in hand, knows

what is going to be done, and is less apprehensive of any rough movement.

The same thing may happen when one of the bones is broken; a sprain and a fracture may occur in the same limb from the same accident, and owing to the great amount of attention paid to the one, the other may be altogether overlooked. Dr. Bennett, of Dublin, narrates the case of a man who slipped as he was carrying a heavy sack down a sloping plank. His foot was suddenly checked in its slide by some irregularity, and he fell, conscious at the time that something had given way in his leg. Admitted into hospital, as he was unable to bear any weight on his limb, he presented the ordinary features of sprained ankle, without any sign of fracture. The case was treated as a severe sprain, and attracted but little attention for some days, until it was noticed that there were some signs of bruising on the upper part of the leg. On examination, the localized pain, and the crepitus characteristic of fracture, left no room for doubt as to the diagnosis. In addition to his sprain, the small bone of the leg had given way a long distance from the ankle, though he was certain he had not struck it in his fall. The amount of displacement of the broken ends was very slight; the line of fracture was oblique; and there is no doubt it might easily have been passed over altogether. Probably, as Dr. Bennett suggests, accidents of this kind are much more common than is usually supposed.

Swelling.—Much of the difficulty of diagnosis arises from the variety of the symptoms presented by sprains; they are scarcely alike in any two cases. In hinge joints, for example, the mischief falls on the ligaments which oppose a twisting force; in a ball and socket arrangement, the muscles, as a rule, are the greatest sufferers. Sometimes, especially when it is due to hæmorrhage, the swelling makes its appearance at once, and accurately reproduces the shape of the synovial sac. At others the bursæ or the tendon sheaths in the neighborhood are distended, so that this is quite concealed, or there are extensive extravasations into the loose cellular spaces underneath the skin and between the muscles. Or, again, the swelling may commence slowly and gradually, twelve, or even twenty-four hours after the injury, and be smooth and uniform in outline from the very first, owing to the effusion into the soft tissue round as well as into the joint itself.

Very often it is most distinct over the course of the muscles and tendons. The skin, for example, on the outer side of the forearm is raised and puffy over the insertion of the pronator radii teres, or there is a long, low, rounded swelling on the back of the wrist, running obliquely across the joint over the course of the extensor muscles of the thumb. It is quite soft—so soft, indeed, that it can often be appreciated better by the eye than by the finger—never very great, because there is no cavity of any size in which fluid can collect, but exceedingly tender when touched.

Sometimes, instead of the bony prominences being partly buried by the collection of lymph round and between them, the reverse of this is the case. They are increased in size, and stand out under the skin in such a way that there may be some apparent ground for the common conclusion that the joint is out. In the wrist and hand this is a very frequent mistake, and it really is difficult sometimes, when one of these points is projecting beneath the skin, to prove that the bone has not slipped out of its place and been dislocated.

The styloid process of the ulna on the inner side of the wrist is a favorite spot for this. It is often unduly prominent after an attack of gout or rheumatism, and, even when it is certain there has been no injury, it is frequently described as being out. So with the base of the metacarpal bone of the middle finger, which, when the wrist is strongly bent, raises up the skin on the back joint. This often forms a projection, especially in gouty people, varying in size from time to time, and occasionally appears quite suddenly after even slight exertion. Probably it is due to a strain of the tendon attached to this point, and to the amount of effusion thrown out round the bone, but it is nearly always asserted that something is out of joint.

Other parts of the body are not so liable to mistakes of this kind, in all probability because they are not exposed to such continual and minute examination. In the knee and elbow, even, considerable differences are not noticed unless they have appeared suddenly. Natural projections may increase in size, fresh ones may form, or what is perhaps more perplexing still, small ganglions may develop in such places as the outer side of the knee joint, just below the level of the knee cap, and at the same time there may be real impairment

of mobility and strength, but unless this happens suddenly, or, what is far more common, is noticed suddenly, little attention is paid to it. When there has been a recent accident the diagnosis is sometimes very difficult, and requires the greatest care.

Staining.—Valuable information may be gained sometimes from the place at which the bruising first shows itself. Blood effused deep down in a limb, as, for example, between the superficial and deep muscles of the calf of the leg, or in the groin, always follows certain well-defined routes, being guided by the anatomical structure and the arrangement of the sheets of fascia. When the limb is bandaged it is often driven great distances by the pressure before it can reach the surface.

Sometimes its distribution is very peculiar. I have seen several instances in which, after a severe injury to the deeper parts of the hand, dark purple crescents caused by blood-staining made their appearance between each of the fingers, just above the web where they divide. Owing to the attachment of the palmar fascia, the coloring matter had soaked through to the skin in a regular and symmetrical pattern.

Pain.—The character of the pain, if the patient can describe it, may be of great help. When the strain falls on the ligaments it is usually said to be sickening, and a patient who has suffered from it once rarely fails to recognize it a second time. It is very sudden, often so severe as to cause the sufferer to faint, and then gradually, if the joint is kept quiet, passes off again, leaving an aching deadness of the limb, but coming back in an aggravated form on the least attempt at movement. This is well marked when a tendon, or one of the internal structures of a joint, slips from its place. So long as the part is kept perfectly still, even if the position is abnormal, the pain is only moderate in severity; it becomes worse and worse as the structure shifts from side to side, until just as it slips back into its bed it is as severe as ever; then it suddenly ceases. The cause at first is the forcible stretching of the ligaments; the later aching seems, in the majority of instances, to be proportionate to, and therefore probably dependent on, the amount of distention of the joint.

Tenderness.—Muscular strains, on the other hand, are distinguished by a peculiar sensitiveness of skin, most marked over the points of attachment to the bones or tendons. These,

as a rule, are the weakest spots, where they give way first. If they are even touched the patient shrinks away with the pain; but curiously enough, very often steady, gentle pressure is well borne. The same thing happens when the muscles are overworked, especially during convalescence. At this time the exertion even of sitting upright is sufficient, because the work, trivial though it is, is too much for the muscles in their weakened state.

When a muscle is torn across, either wholly or partially, as in some cases of lawn-tennis leg, the symptoms are of a totally different character. There is a sudden sharp pain, like that of a blow with a whip or a cricket ball, so that the patient turns round to see who has struck him, before he is aware that anything has given way; and then, as the swelling begins, this is followed by a feeling of stiffness and soreness, severe even when the limb is at rest, but so much worse when an attempt is made to use it, that the patient often can hardly be induced to try.

Dislocation of a muscle is not unlike this. There is the same sudden pain, and the part is held fixed in the position of the moment, no matter how inconvenient it may be. If, for example, one of the muscular slips in the neck is displaced by some irregular movement, the head is kept rigid in the position into which it was twisted. It is not possible for a time to bring it straight again, much less to make it face in the opposite direction; only after the first pain has subsided can it be brought round by slow degrees. Even then, as soon as the attention is withdrawn, it quietly, but surely, moves back so long as the displacement is uncorrected. When the parts are restored there is nothing but a sensation of soreness, with a tender spot or line in the neck corresponding to the particular slip displaced.

These tender spots often afford valuable information. They may persist long after apparent recovery has taken place, and they generally point to something which is not quite restored. In a sprained ankle, for example, if one of the lateral ligaments has given way, or has torn off a scale from the bone to which it is attached, that spot remains tender for weeks after. Sometimes they indicate the presence of adhesions, or of tough contracted parts of the capsule; occasionally they correspond to the situation of synovial fringes, or foreign bodies, or to the

places at which the nerves enter the joint; and in one or two instances I have known them caused by extravasation in the substance of the capsule itself.

Allowance must be made for those that are normally present when a joint is hurt. What they are caused by is not always certain, but as a rule they correspond to places where the capsule is thin and flexible, and not far removed from the surface, so that pressure falls on it directly. However this may be, they are so constant and definite that it is scarcely possible to mistake them. There is one, for example, nearly always present on the inner side of the knee-cap, about the middle of the joint; in the hip it lies behind the projection of the trochanter, and sometimes there is one also on the inner side. In the ankle they are not so marked, but there is very generally one on the front of the joint, rather to the outer side of the middle line. These are present with such regularity that they must almost be called normal. When other more unusual ones are found there is some additional reason to account for them.

Sprains and Dislocations—the Elbow in Children.— Sprains and dislocations are sometimes very confusing, even without taking into consideration the popular view that something is out of joint in every sprain that does not get well at once. One instance in which there is great difficulty in distinguishing them has been mentioned elsewhere, and it would be easy to multiply them. There is, for example, a peculiar injury about the elbow, only met with in children, concerning the nature of which there is still very considerable doubt. It is caused by the way in which they are swung round by the hands, or lifted across a road; and is rarely seen immediately, for though the child cries out with the pain, there is no distinct or objective sign of anything wrong. Then it is noticed that the arm is not used as freely as the other; that the child always cries when it is touched; and that it is held constantly in one position, the elbow slightly bent, and the palm of the hand looking downwards. Now, certainly, in the majority of instances the seat of the mischief is in the elbow joint (J. Hutchinson, Jun., "Annals of Surgery," 1885); and it is highly probable that it is due to one of the bones of the forearm, on which nearly all the weight falls, slipping out from under the ligamentous collar which holds it in its place. But this view

is not by any means universally held; others, describing the same accident, produced in the same way, causing the same symptoms, and, more than all, cured by the same manipulation, have assigned it to a totally different joint, the wrist.

It is even mistaken for fracture sometimes, for a very simple but altogether insufficient reason. If the elbow is held firmly with one hand, while the forearm is made to rotate slowly from side to side, there is a clicking or snapping sensation, perceptible both to the ear and the touch. Then something is felt to slip, and in general free use of the joint returns immediately. But sometimes this is not so easy; reduction does not take place at once; the peculiar sensation continues, and may even become more plain, until it is really difficult to distinguish it from the crepitus of fracture. It is needless to remark that whatever may be the actual nature of the hurt sustained, it can scarcely be this. If the displacement is rectified, and the arm kept quiet for a day or two, recovery is nearly always complete and thorough, which, under such conditions, would, of course be quite impossible.

These cases are of everyday occurrence; though there may be minute points of difference, they resemble each other in all important features; the anatomy of the part is thoroughly well-known; the way in which the mischief is produced can generally be ascertained; and there is nothing mysterious, or even unusual, in the manipulation by which the parts are restored. Yet in spite of all this, not only is the actual nature of the injury doubtful, but even its locality is uncertain. When there is no history to be obtained, or only one that is confusing and misleading, and when the limb is stout and shapeless, or so much swollen that nothing can be definitely felt, the difficulty of forming an exact opinion, of making absolutely certain at once that the joint is not dislocated or the bones broken, may be easily imagined.

The close resemblance that exists between many dislocations and some forms of sprains ceases to be astonishing if it is remembered that, as Vidal de Cassis pointed out, they are really the same thing, only that in the case of the former reduction has taken place spontaneously. In the one the articular ends, which at the moment of the accident are wrenched apart, slip back again into their natural position of their own accord; in the other they slip still further aside.

Sprains and Fractures.—Ordinarily speaking there is not much difficulty in distinguishing sprains from fractures. One may easily be overlooked when both are present at the same time, especially if they occur, as they easily may, at the same spot; but in other cases the signs are usually distinctive. The rough grating sensation when two broken ends rub against each other, the undue mobility, deformity, and pain present in most cases of fracture, are nearly always sufficient, though, as will be described later, some of these signs may be imitated exceedingly well by other conditions. If, however, the bones are so driven into each other by the violence of the accident that there is no undue mobility, especially if in addition the line of fracture runs through that part of the bone which lies immediately inside the capsule of the joint, it is not always easy to make a distinction.

In the case of the hip this is well known, but accidents of a similar description, with or without impaction, are met with sometimes in other joints as well.

Sprain Fractures of the Thumb.—The thumb, for example, is liable to a peculiar form of injury, the real nature of which has only recently been explained. It follows in general a severe strain. The ball of the thumb swells up at once, and all power of bending it into the palm of the hand, or bringing it towards the other fingers, is lost. On the back of the bone, just where it joins the wrist, there is a distinct projection, not nearly so large as it would be if the joint were out, and rectified at once by pressure, only as soon as the pressure is removed it returns again, with a visible and painful jerk. If the two hands are compared together the length of the bones corresponds exactly, so that it does not look like a fracture; it cannot be a complete dislocation, and a partial one from the structure of the joint is impossible. In reality the injury partakes of the nature of both. There is an oblique fracture through the base of the bone, where it joins the wrist, splitting off that part which lies deeply buried under the muscles of the ball. It does not involve the back of the bone, so that the measurements are unaltered, but owing to its carrying away with it the projection on the palmar surface that serves to make the joint secure, the rest of the bone slips back and sticks up under the skin. The crepitus, when pressure is made from front to back on the ball of the thumb, and the broken

surfaces are rubbed together, can be felt quite easily, and the pain is greatly increased thereby. The ultimate deformity, if the injury is not diagnosed, is not so serious as might be imagined, but the movement of the joint is interfered with for a considerable length of time.

CHAPTER IV.

NATURE OF THE INJURY.

Sprains differ a great deal both in the nature and extent of the injury. Sometimes it appears to be quite trivial; there is merely the slipping of a disc of cartilage from between two bones, or the displacement of a tendon from its groove; sometimes everything that holds the two joint surfaces together, with the exception of the skin, is torn and lacerated as it is in a dislocation. In many cases the injury is really as great: the bones are wrenched apart from each other at the moment of the accident, only instead of being caught and held, as they are in a dislocation, they fall back again of themselves into their natural position. Such accidents are always called sprains; but the tissues suffer as much as if the joint had really been put out.

The extent to which the tissues are torn at the moment is not the only thing that has to be taken into consideration. The symptoms and the after consequences are often most serious when this is apparently but slight; and the liability to inflammation, and other troubles, depends a great deal more on the constitution of the patient, and the way in which the sprained joint is treated, than on the number or size of the structures that are torn. So long as the natural process of healing is still in its full vigor, as in children and young adults, injuries, no matter how serious they are, are repaired without the least difficulty. The treatment must be well planned, it is true, and thoroughly carried out; proper care must be taken that the parts are not subjected to too severe a strain before they can stand it; but if this is done, after consequences of any kind are the exception. Unhappily as time goes on the effects of age and of constitutional frailties become so powerful that in many cases, in spite of every care, a comparatively trivial injury often leads to the most serious results, and re-

covery is delayed indefinitely, or remains imperfect perhaps for the rest of life.

Opportunities for examining joints shortly after they have been sprained are not very common, though they occur sometimes when a patient has received other and more serious damage in the same accident. By taking advantage of these a fair amount of information has been obtained with regard to ordinary cases; and the results have been confirmed by Bonnet, of Lyons, and others, who have made use of other methods. Many special sprains, however, such, for example, as the internal derangement of the knee-joint, first described by Hey, are still involved in a certain amount of obscurity. They are not uncommon; for years past they have attracted an unusual amount of attention from the inconvenience they cause, and the striking character of the symptoms that attend them; but the joints in which they occur are so complicated, and opportunities for examining them so rare, that there is not as yet any settled opinion as to what the nature of the accident may be. It does not seem unlikely that the actual displacement varies in different cases, even though the external symptoms are to all appearance the same.

Generally speaking, the tissues on one side of a joint are overstretched and torn; those on the other compressed and crushed together; but there is always so much twisting, and such a difference in the strength and power of resistance of the various structures, that unless the part is examined with the greatest care it is almost impossible to say what actually has given way. In every case no pains should be spared to find out the whole of the mischief with as little delay as possible. There are many instances on record in which delayed convalescence has been due solely to the fact that a displaced tendon or other structure has not been recognized sufficiently early. The difficulty increases with every minute. Immediately after a sprain, before the position of the parts has been altered by attempts at movement, or concealed by swelling, the nature of the displacement may often be recognized without much trouble. But if the chance is lost, the part begins to throb with pain, swelling sets in and obscures everything, and it is often necessary either to place the patient under an anæsthetic or to wait until the extravasation and œdema have been dispersed.

Hæmorrhage into the Sac.—Most of the swelling that makes its appearance immediately is due to the blood that pours out from the torn vessels. The central cavity of the joint becomes distended with fluid, which varies in character and amount according to the number and size of the vessels in the injured part, and the length of time that has elapsed since the accident. If the swelling reaches its maximum within the first few hours, it is probably due mainly to blood; if twenty-four hours pass by before this, there is a large proportion of lymph mixed with it, and, at the same time, if the joint is superficial, some heat and redness of skin. The amount is very variable; sometimes it is not easy to detect any increase at all; at others, especially if no steps have been taken to check it, the distention is so great that the outline of the synovial sac may be traced distinctly beneath the skin. The delicate structures lining the cavity are torn and bruised, and the vessels continue to bleed until the contraction of their walls and the pressure of the fluid accumulating round them stops the flow. Probably the blood soon coagulates, as it does when extravasated into other tissues of the body; and at a somewhat variable period becomes liquid again. At least, if a joint is tapped or aspirated a few days after a severe sprain, it is found to contain a fluid, which, though it still reddens on exposure to air, differs from blood in color, and in being turbid from floating *débris*. If left to itself, the quantity diminishes, and it undergoes other changes. The coloring matter slowly soaks into the tissues round, so that they remain deeply stained for weeks; the floating fragments become finer and finer, until they, too, disappear; and at length, though the amount remains excessive for a considerable time, it assumes again the character of the natural synovial fluid.

The rent in the capsule may be almost imperceptible, merely a superficial line, extending across part of the cavity, and only marked by an uneven band of discoloration; or it may stretch right across from one side to the other, and open up the cellular spaces round. It is especially liable to give way along the line of its attachment to the bone, and as this is where the blood-vessels are largest and most abundant it accounts in some measure for the amount of the hæmorrhage. At this point there is a considerable thickness of soft loose tissue with little resisting power, and the fibres are more widely spread

out and separated from each other than they are elsewhere, so that when a strain falls on them it attacks them, as it were, in detail, and easily overcomes them. It is very unusual not to find some evidence of violence, some staining or reddening at this point, after a joint has been sprained.

Hæmorrhage in the Synovial Wall.—The extravasation is, however, not limited to the interior. If the cavity is opened there are patches of it, apparently adherent to the inner wall, but really situated within its substance, covered over by so delicate a film of tissue that they can be plainly seen through it. Most of these disappear at length. They merely leave a thickened and discolored spot, which, as a rule, is well out of the way, and causes no inconvenience. If, however, they occur in a part of the joint where the lining membrane is loose and thrown into folds when at rest, or where there are many fringes and outgrowths well protected from pressure, as round the neck of a bone, they sometimes lead to great annoyance. A hard, unyielding patch is formed in the smooth and supple wall; its flexibility is lost, and it cannot yield itself kindly to the movements of the joint, but drags on the other parts, and acts as a continual source of irritation and pain.

These changes are not confined to sprains; they occur after other injuries with almost equal frequency, and may always be suspected when, long after an accident, some particular or unusual spot remains tender, or one special movement is limited in extent. They are particularly common in the deeper layers. The soft cellular pads that are developed in and round joints, for the purpose of filling up spaces that vary in size with every movement, are generally deeply stained with blood. If this is absorbed again no ill result follows; but it often happens, from the soft and yielding nature of the tissues at these places, and from the way in which they are protected from pressure, that when a joint is kept at rest in one position this is never thoroughly carried out. The blood remains for a long time without changing, and then slowly becomes organized into a dense, unyielding mass. The pad which was intended to give way before the faintest pressure, and accommodate itself to every change of position, becomes hard and dense, and moulded to one form. So long as the limb remains at rest it is fairly comfortable; as soon as it is moved there is pain, because the pressure is no longer distributed evenly over the whole surface.

Bursæ.—Changes of a similar character are very prone to occur where there are spaces near joints, in which blood or other fluids collect after injuries. They may be bursæ or mere interspaces in the cellular tissue, without any well-marked limit; some are definite in shape and position, existing, at least in adults, in all alike; but many are accessory, developed here and there by the accidental friction of one structure on another, and, therefore, differing in size and shape and position in each individual. Whatever they are, they act as receptacles for the blood which is extravasated into the tissues after sprains and other injuries. It collects in them and distends them, lining their interior with a layer of false membrane, which slowly becomes organized and makes their wall dense and hard. Then they become tender and painful; their surfaces are roughened and irregular; they obstruct instead of assisting the movement of one part on another; and often, by inducing the patient to keep the part at rest, they lead to other changes, the importance of which is altogether out of proportion to the severity of the original injury.

Some of these bursal swellings are very perplexing. In many cases where there is a large cavity overlying a joint it is very difficult to tell whether the fluid is really in the synovial sac of the joint or outside it. It may reproduce the shape exactly, and by its tension prevent the muscles from contracting as much as if the capsule itself were distended.

In others, especially when the swelling is recent, and there is something firm behind, such as a bone or the wall of the chest, the imitation of a fracture is surprisingly good. There is a sensation of crackling, when the part is handled, closely similar to that produced by rubbing together the two ends of a broken bone. It is really due to the dense fluid being pressed through the meshwork of connective-tissue interspaces which make up the interior of most of these; and it may nearly always be distinguished (independently of the absence of the other signs of fracture) by the difficulty there is in eliciting it a second time, until either the fluid is driven back again or some more allowed to accumulate. There is no difficulty in feeling it once, but it is very hard to demonstrate it to another person.

When extravasated blood collects in the space between the shoulder-blade and the back the sensation is most deceptive.

I have known many instances in which a mistake has been made through relying on this, fractures of various parts of bone having been diagnosed, in spite of the absence of displacement and of tenderness on pressure. This occurs, too, in other situations. In one case in particular the patient, who had on a previous occasion suffered from several fractures in different parts of his body, was so firmly convinced that his collar-bone was broken that nothing could make him believe the contrary. He had sustained, certainly, a severe fall on his shoulder, and was badly bruised; there was great difficulty in raising his arm from the side, and the whole region was much swollen; but there was no displacement of any kind, and the tenderness was general, not limited to any one definite spot, as it would have been in the case of a fracture. On manipulation, however, the most distinct crepitus would be obtained, especially when the arm was lifted up, and the shoulder grasped firmly from before backward by the finger and thumb; and it was so definite in character, and so perceptible to the patient, that he was absolutely sure that it came from his collar-bone. Not until ten days had passed, when he could use his limb freely in all directions without pain, would he admit that the fracture (if it was one) had united very much more rapidly than those he had sustained on a previous occasion.

In this case there was undoubtedly a large extravasation of blood into the bursa which covers in the shoulder joint. Very likely its walls were torn, or crushed and bruised with some of the muscular fibres lying over it. Raising the arm pressed its sides together, so that the fluid was driven from one part to another, and squeezed among the irregular meshes that lined the interior. Later on this was absorbed; the staining made its appearance in the usual situation, under the borders of the deltoid, and as there was no permanent thickening or rigidity of the walls, movement was completely regained. All cases are not so fortunate. It is not uncommon to find the interior of this bursa lined in all directions with shaggy villous projections, hanging down in the cavity, the result of repeated injury or inflammation, and the cause of constant inconvenience and even pain.

The Ligaments.—The extent to which the ligaments are injured varies quite as much. It is no uncommon thing to find the strongest in the body, such as the internal lateral

ligament of the knee or ankle, completely torn across, and the joint as full of blood as it can be; or, on the other hand, there may be scarcely a bruise or tear. They are really part of the capsule uniting together the ends of the bones. The structure is the same in all essential particulars, and they are practically continuous; only the arrangement is different; in the one, the fibres are scanty and weak, with many and large inter-fibrillar spaces; in the other, they are arranged in closely woven bundles, parallel to each other, and so tense as scarcely to admit of any elongation by sudden violence. They may tear, especially small portions of them here and there, so that the whole thickness is not broken across at any one spot; but they will not stretch. It is true that under certain conditions they do become elongated, but this only happens when the strain is continuous, and lasts for some considerable time. A slight degree of inflammation sets in then, and under its influence the fibrils soften until they yield

Sometimes ligaments give way in the middle, but it is more common for them to separate from the bone, or to wrench from it a small thin scale corresponding to their attachment. This is due in part to the arrangement of their fibres. In the centre they are woven closely together, and form a rounded bundle of great strength; at the ends they spread out like a fan, so as to secure a wider attachment. By this their mutual support is lost, and the course of the fibres is altered, so that the direction of the strain no longer coincides equally well with that of all the strands. Owing to this they give way much more easily. A ligament that can resist successfully a straight pull of great violence yields at once to a twisting force of much less severity, because this falls on the fibres unequally, one by one, and tears them from their attachment.

Intra-articular Ligaments.—Some of the structures that lie in the interior of joints occasionally suffer in a peculiar manner. Inter-osseous ligaments, formed of very short numerous bands of fibres connecting immediately two roughened bony surfaces, rarely give way, owing to their great strength, the bone yielding instead; but the discs of fibro-cartilage, which are interposed in places between the bones for the purpose of deepening the sockets, and modifying the effect of shocks, are very liable to suffer. Sometimes they are bruised or crushed; more often they are torn from their attachments

and displaced, so that they interfere with the working of the joint. Or, without being actually separated, they may be so stretched that the result is much the same. This is best known in the knee; in other joints in which discs of this kind are found they are so much smaller and so firmly fixed that they rarely give rise to any inconvenience. In the knee they are very large; their normal range of movement is very considerable, and they are so loosely held that displacement is not only easy, but, when it has once been produced (owing to the feebleness with which repair takes place), is always liable to occur again.

The Knee.—I am not aware that there has ever been an opportunity for examining the interior of a knee joint shortly after this had happened for the first time, and before the disc has been replaced. Indeed, from the nature of the accident, it is scarcely likely there could be such, except under the strangest coincidence; but on several occasions the joint has been opened and the displacement verified after it has occurred repeatedly. And often the patient is aware of a projection from the side of the knee, caused by the displaced disc. There is, therefore, no question as to the nature of the accident, but, as has been already mentioned, it is by no means certain that this explanation serves for all the various forms of internal derangement that have been described, even when full allowance is made for the different directions in which it may take place.

The Fingers.—The finger joints, again, are the seat of a peculiar kind of injury somewhat similar to this. They all of them belong to the class of hinge-joints, admitting free movement so far as flexion is concerned, but exceedingly little in any other direction. On the under surface of each there is a plate of fibro-cartilage, similar in structure to the discs in the knee joint, and, like them, helping to deepen the socket in which the head of one bone rotates. In fact, this is the chief bond of union between the bones, but while it is so firmly united to one that it is almost impossible to tear it off with any reasonable degree of force, the fibrous tissue that binds it to the other is soft and flexible, so as not to interfere unduly with the action of the joint. Sometimes it happens in severe wrenches, especially when the finger is forced backward, that this plate of cartilage is torn from its attachment, and slips

up between the bones, so that when the force is past they cannot resume their natural position.

Mitchell Banks has shown how this occurs in the joint between the index finger and the hand, in which it is most common; and I have met with several instances, not only there, but in other joints also. It is an exceedingly painful accident, often causing fainting and sickness. The deformity is very conspicuous, especially in the back of the joint, though it is not so great as that of a true dislocation or when a bone is broken. The finger is kept slightly bent. By using the other hand the patient can move it through a considerable angle, but he cannot either straighten it out or bend it thoroughly into the palm. No amount of force produces any effect in the displacement; it is due to the cartilage which has slipped between the ends of the bones and prevents them moving freely on each other. Until this is released from its position the deformity must remain unrelieved. If left to itself the finger generally recovers a good deal of its power, but the appearance is very unsightly.

The Muscles.—The muscles round joints rarely escape when the sprain is severe, though the injury may at first be masked by other symptoms. Sometimes it is very serious, but this depends probably on their condition at the moment of the accident. If they are firmly contracted and ready to resist, the joint does not suffer unless they are overcome, and then the injury is generally too great to be called a sprain. Most often they are taken by surprise, and are hurt more by their own sudden and spasmodic effort at recovery than by anything else.

The weakest part of a muscle varies a good deal according to its shape. When they are short and broad, with wide attachments to the bones and firmly bound down by sheets of fibrous tissue, there does not seem to be any definite rule. Probably the part that gives way first is determined mainly by individual peculiarities of structure; but when they are of considerable length, and attached to distant bones by rounded tendons, the weakest part is the line of junction between the muscular fibres and the connective tissue. It is at this point that they tear, causing a great extravasation of blood, and giving rise to a swelling which at first is soft and fluctuating, but which soon becomes hard and solid, and may persist in that condition for an almost indefinite period.

This often happens when the fibres are torn across, while the dense unyielding sheath that surrounds them remains intact. The extravasated blood is tightly bound down, and forms a hard resisting nodule, the nature of which can only be ascertained by the rapidity with which it occurs and the way in which it is confined to the limits of the muscle. I have recently had under my care a patient with a nodule of this kind in one of the muscles of the neck just where the tendinous and muscular fibres meet. It made its first appearance quite suddenly during a violent effort, with all the characteristic signs of muscular rupture, more than a year before, but in spite of energetic treatment by massage and other methods it was nearly three months before it finally disappeared.

When a muscle gives way completely, it is usually at the same spot. A curious instance of this is not uncommon among butchers. They occasionly lose the last joint of their thumb by catching it in a hook and tearing it off. The skin and the ligaments give way at the seat of injury, but the tendons of the muscles retain their connection with the bones. The long flexor is pulled out of its sheath for five or six inches, one end remaining attached to the bone, the other bringing away with it torn shreds of the muscular fibres that have given way above the wrist.

Rider's Sprain.—Sometimes the muscles are torn and strained without the joints being hurt at all. Those, for example, that lie on the inner side of the thigh occasionally give way under the semi-voluntary grip by which a rider secures his seat when his horse swerves or bolts round. There is a sudden sharp contraction, a sensation of something giving way, and a feeling that the hold on the saddle is gone. A dull aching pain sets in at once, and grows worse and worse with every attempt to proceed; the part begins to swell as the blood pours out from the torn vessels; a peculiar warm trickling sensation is felt down the inner side of the leg, and, as a rule, the rider is compelled to dismount. When standing, the symptoms are not quite so severe, but the least attempt to bring that group of muscles into play again, or to remount, makes them tenfold worse.

The kind of injury is well known, and is usually recognized at once. It is due to the rupture of the tendon that stands out under the skin on the inner side of the thigh; sometimes it

gives way near the bone, so that the gap can be felt, but more often the muscular fibres are torn away from it without leaving any distinct interval. The extravasation is often very extensive, and it may be weeks before the last traces of the staining finally disappear. Every endeavor must be made to keep it as much as possible within bounds. A stirrup leather may be tied tightly round the part as a temporary measure; but a much more effectual method is to buckle a long strap of webbing round the thigh, outside the breeches. It must be well padded, on the inner side, over the point where the muscle is torn, and coming up in front and behind, should cross over the hip and be carried round the waist. Where the laceration is complete, some such appliance may be permanently required.

Rider's Bone.—A long slender spine of bone which is occasionally met with in connection with these tendons probably has its origin in the same kind of injury. It is known as rider's bone, from its being found chiefly in those who have spent a large proportion of their lives in the saddle. Sometimes it causes a good deal of inconvenience by the way in which it interferes with the flexibility of the part; but more often its existence is hardly known, as it lies buried in the substance of the tendon itself. If the history is inquired into, it is always said to have developed after one single severe strain; but comparing it with similar formations in other tendons, it seems more probable that it is due to the constant bruising to which the muscles are subjected. Probably it is formed from the organization of lymph thrown out from time to time.

Rider's Bursa.—Other troubles also are produced in this way. A soft fluctuating swelling sometimes makes its appearance underneath the tendon, high up in the groin. So long as the muscle is in action it is tense and firm, as soon as it is relaxed it becomes soft and flaccid; but it cannot be dispersed, or even reduced in size, by pressure. In one case under my care, considerable improvement was effected by rest and blistering, but I am afraid it was not permanent. The patient was a man who had been accustomed to a great deal of rough riding, and it seemed to cause him considerable annoyance. The thing of which he complained most was a sensation of weakness, similar, apparently, to that which is so often experienced in the hand when there is a ganglion on the back of the wrist; but it was doubtful if there was any actual loss of

power. The swelling had made its appearance slowly, and was still increasing when he came to see me, so that it evidently was not due to any extravasation. Most probably it resulted from the effusion poured out after repeated strains; and, as he could not give up his occupation, it is certain to increase, until it ends either in inflammation and suppuration or else in the formation of a bursa.

Lawn Tennis Leg.—Lawn tennis leg is another instance. This was a well-known form of accident long before lawn tennis was ever played; but it has become so much more common, as the game has grown popular, that perhaps the name is not inappropriate. It is most frequently met with in men, especially in those who, as youth passes by, are beginning to increase in weight, and whose muscles are somewhat out of training; but not improbably there are other causes too. It is decidedly rare, for instance, among the laboring classes; I am not aware myself of having seen any example among the out-patients at hospitals; and, whether it is worth anything or not, it is certain that in a very large proportion of the cases some evidence of gout may be found, not necessarily of any very acute attack, but merely of those indefinite forerunners which are often quite as distinctive. Generally speaking, it occurs during some sudden and violent effort, a sudden spring forward to take a ball, for example; but the merest slip is enough. Indeed, in some cases it is so difficult to obtain a definite history of such an accident that I am rather sceptical as to its really being required. I have known at least one in which it occurred while the patient was walking along a level road, on which there was not even a projecting stone.

The symptoms are exceedingly characteristic. All of a sudden there is a sharp stab of pain in the calf of the leg: the patient stops instantaneously, lifts his foot from the ground, and nearly always looks round to see if some one has not struck him a violent blow with a stick or a stone. Rest his weight on the leg he cannot; the pain, it is true, does not continue with the same intensity, but the recollection is such that nothing will induce him to try. When the part is examined, there is generally nothing to be seen: but there is an exceedingly tender spot in the substance of the calf, and sometimes a slight depression can be felt. Later on, marks of bruising make their appearance, yellow at first, but gradually becoming darker as

the coloring matter approaches the surface, and, generally speaking, most plain toward the lower part of the leg, even when the painful spot is nearer to the knee. This, however, is liable to be modified considerably if the part is well bandaged. In one or two cases I have noted a slight degree of puffy swelling behind the ankle, and it is said that occasionally the foot is deflected somewhat from the straight line; but this I have never seen myself, and I should feel inclined to assign it, when it is present, to secondary changes taking place in the smaller joints of the foot, consequent on the very unequal and unfair degree of strain thrown on them.

The usually received explanation of this very striking accident is that it is the result of the rupture of an exceedingly small muscle, known as the plantaris, situated in the substance of the calf of the leg. The muscle itself is in many respects most peculiar; it is very deeply placed, lying under the largest muscle of the calf, is itself exceedingly short and weak, being rarely three inches long, and is provided with a prodigiously long tendon, which either joins the tendo Achillis at the back of the heel, or else is attached to the bone in close proximity to it. Whether rupture of such a structure can take place or not is almost impossible to prove; the fact is commonly asserted, and it is usually admitted as an explanation of the symptoms, but I am not aware of any instance in which it has been actually shown. It is quite certain that the same effect may be produced by other causes.

This explanation, for example, does not answer when the same accident occurs twice in the same leg at different places. A striking instance of this recently came under my notice, the interval between the two occurrences being only a few weeks. On the first occasion the middle of the calf of the leg was the part involved; on the second it was at least four inches lower down, and nearer to the ankle. Nor was this to be explained as the rupture of muscular adhesions that had developed during the period of convalescence; for not only had there been nothing to occasion them in this locality, but recovery was practically perfect, so that the patient could walk without inconvenience, and without any apparent limping. The second accident was precisely of the same nature as the first; there was the same sharp stab of pain, with tenderness, and a slight amount of swelling, and the same feeling that it was impossible

to place the foot upon the ground; but clearly it could not be due to the tendon. This, if it had united at all, could not have been sufficiently firm to withstand a strain that compelled it to give way at another part. The scar could not have been so strong as the original structure.

W. Hood (Lancet, 1884) considers that it is the result of the rupture of some portion of the muscular or tendinous structure of the calf, without specifying it more particularly; and no doubt this is correct in many instances, especially when a depression can be felt by the finger where the fibres have given way. Rupture of the plantaris, which is comparatively a deeply-seated muscle, could never cause this. I would venture to suggest, however, that, in those cases at least in which the amount of blood extravasated is considerable, the cause is connected with the condition of some of the deep intermuscular veins. In many instances they are unusually large; they become varicose, nearly to as great an extent as the superficial ones, and there is no doubt that sometimes they give way, or become blocked by the development of coagula in their interior. This naturally causes very severe pain, owing to the way in which the nerve-fibres are stretched or compressed; and unless absorption is completed very soon, is sure to leave behind a considerable degree of stiffness. The degree of pain that is caused by the rupture of a small vein, especially when the extravasated blood is bound down by surrounding textures, is something surprising so long as it lasts.

The method of treatment to be adopted in these cases is admirably described by the same writer. He recommends that as soon as possible after the accident the patient should be placed in the recumbent position, with the injured leg raised above the level of his head, and should be kept in this position for five minutes. This is very important for two reasons. In the first place, the leg is emptied at once of all superfluous blood, so that the swelling soon goes down. When a limb is raised in this fashion the artery contracts; much less blood flows to it, and the veins are so rapidly emptied that if a superficial one has given way this alone is sufficient to stop the bleeding. The calf, which is enlarged and hard, returns to its normal size, and the patient at once obtains relief from the distressing feeling of tension. But besides this, if the elevation of the limb is neglected, the plaster next to be described is

loosened by the subsidence of the swelling, and requires to be replaced in a few hours. He then advises that while the leg is still raised strips of adhesive plaster, each an inch and a half in width and of length adapted to the size of the limb, should be applied from two inches above the ankle joint to above the thickest part of the calf, somewhat as strapping is applied in the treatment of chronic ulcers of the leg. As soon as it is applied the patient should be directed to walk about the room, and to place the heel firmly, or at least fully, on the ground at each step. For the first dozen steps he will probably hesitate, and will retain more or less of the limp with which he entered; but after a short time, finding that his pain is diminished or possibly removed, he will gain confidence, and will walk with a pride in his own performance which is very interesting to witness. This description is exceedingly accurate:—"Until this point is reached he should not be suffered to depart; for, if he does not walk properly before he leaves the surgeon, he will hesitate still more when alone, and will be likely to return to the ungainly progression which he exhibited at the commencement of the interview. Success in walking, in the first instance, will depend largely upon the temperament of the injured person. A resolute man, who believes in his doctor, will walk at once, while a more timid patient will require coaxing and urging. The chief trouble will be with the sceptical man, who has his own 'views' about the injury, and who will express them in such questions as, 'Well, but do you not think there is a risk of inflaming my leg?' 'Shall I not make the internal wound larger?' and so forth. With reasonable care neither to jerk the leg nor to twist the ankle on uneven ground, the patient, as soon as the plaster is applied, may walk about as usual. By the third day the plaster will be somewhat loose, and the patient will say that he is not quite so comfortable as before, and is less inclined to trust his leg. The strapping should be reapplied, and he will at once feel more secure and better able to walk. Four days may elapse before the next strapping, which may be left untouched for a week, but the application should be continued at intervals until the patient is quite convinced of his ability to do without it. On the first occasion very little pressure is desirable, and mere laying on of the plaster will be sufficient. Subsequent strappings should be tighter, but never

so tight as to produce a sense of unpleasant constriction, a rule which must be especially borne in mind in applying the first and last piece. The amount of walking should be increased daily, and after the third day the patient should go up and down stairs freely in the usual manner. Until then his ascents and descents may be infantile."

I would only add that in those cases in which I believe the real cause to have been the rupture of some deep-seated varicose vein, I have found the above-mentioned method of treatment as successful as when the muscular fibres were plainly torn. In other parts of the body partial rupture is equally common. Sometimes only the sheath of fibrous tissue that surrounds the muscles gives way; the soft tissue is squeezed out through the rent, and so tightly constricted at the opening that it becomes forced into the shape of a mushroom. I have seen this in the extensor muscle on the front of the thigh. It was attributed at the time to the fact that the patient received a violent blow on the spot from a blunt piece of iron at the moment of vigorous contraction. The symptoms, however, were not well marked, and as recovery was complete without further inconvenience than a small depression in the substance of the muscle, nothing further was seen of it.

Many other tendons occasionally give way during great exertion. Even the stoutest, such as the tendo Achillis, may be torn across, though it is more common for the bone or the muscle to yield instead. I have in my possession a shoulder joint in which the long tendon of the biceps has been ruptured about an inch and a half from its attachment to the bone, so that the end projects into the cavity of the joint. The other part has formed for itself a secondary attachment on the floor of the groove in which it normally lies. Similar changes have been described from time to time in connection with many others.

Dislocation of Tendons and Muscles.—When the injury falls short of actual rupture it may still be very severe, and lead to a great deal of after trouble. Tendons, for example, where they cross a joint or run over a projecting process of bone, lie in grooves, which are lined with a delicate sheath similar to that in joints, and this rarely escapes. In slight cases it is merely bruised where the tendon presses against it, but it may be filled with extravasated blood, or be torn open

down the whole of its length, while the tendon escapes and lies displaced among the adjacent tissues.

In the Back.—Both muscles and tendons may be dislocated in this way. Callender and others have shown how this happens where long and slender slips lie embedded among shorter and stronger ones, as in the back and some parts of the limbs. The muscles are closely packed together, surrounded, and at the same time separated from each other, by fibrous tissue, which is dense and firm toward their ends, soft and yielding at their centre. In all ordinary movements, carried out in an orderly fashion, with a definite object in view, the action spreads, as it were, from one muscle to the next. Very few are carried out by the contraction of a single one. Nearly all involve not only those immediately necessary, but those also by their side, which are more or less parallel in their course. The shape and consistence alter together, so that their mutual relations remain unchanged. When the contraction is sudden and spasmodic, it sometimes happens that one of these slips from its bed between the rest, tearing its fibrous sheath, and becomes displaced or dislocated. Probably this is due to the irregular and disorderly fashion of the contraction. There is a sudden pain, quite local, but made worse by any movement that would call that muscle into play, sometimes so severe that such movements cannot be executed at all. The surface of the skin is slightly raised if it is superficial, and nearly always there is considerable local tenderness.

These symptoms are, it is true, very nearly the same as those of partial rupture, which is a great deal more common; but there is no question that dislocation does sometimes happen, as complete and almost instantaneous recovery takes place as soon as it is reduced. In some instances the patients have actually felt the muscle slip back into its place again; and in a few it has been known to slip in and out again and again, owing to incautious movement at a too early period.

The Sartorius.—Large muscles, too, are occasionally displaced. A remarkable case has been recorded in which the sartorius was detached from its position on the inner side of the knee by an accident of this kind. Just before its attachment to the bones of the leg, this muscle gives off from its border a tough fibrous expansion to the capsule of the joint. This was torn across, and the muscle itself displaced. The

accident befell a man who was squatting on the floor of a wagon in the position assumed by tailors. A companion tripped over him and fell across his knees; something was felt to give way near the ham, and on examination the above mischief was made out. In another instance under my own care, after a somewhat similar accident, there was much tenderness, and a soft ill-defined swelling over the inner side of the knee for a considerable time; and all the movements that require the assistance of this muscle were very painful, as if some of its fibres had been torn across.

Peronæi Tendons.—The tendons of the peronæi muscles, again, are not unfrequently displaced from their position behind the outer ankle. The sheath that confines them in their groove is torn down its whole length, and they slip forward on to the bone. In the two examples that have come under my immediate notice, neither of the patients was sufficiently trained in accurate observation to give a reasonable account of the way in which the accident occurred. It is not hard, however, to conjecture the direction in which the foot must have been twisted for such displacement to be produced. One of them had sprained the same joint already several times before, and although the tendon had never been completely displaced, it is by no means improbable that the constant repetition of the injury had caused the sheath to stretch until it became too weak to resist. It is possible, too, that the groove in the bone had become partly filled up by the lymph thrown out. In neither was there the least difficulty in reduction; but while this was successful and permanent in the case of the one, in the other the least movement caused them to slip over the bony margin again, confirming my suspicion that the mischief was not due to one accident only. Bandaging, strapping with pads in all positions, fixed apparatus of many kinds, complete rest, with the foot kept at a right angle for weeks together, all were of no service. Gradually the inconvenience became so much less that the patient would not submit to any further treatment. At first, each time they slipped forward there was the peculiar sickening pain common to all overstretched fibrous textures; but soon this, too, ceased to be felt, and the patient having had no arch to his foot for some long time before, the comparative loss of these muscles was not so serious to him as it otherwise would have been.

On the Hand, etc.—Other tendons do not so often suffer in this way. Paget has described displacement of some of the extensor ones on the back of the wrist; but though a slight degree of slipping and yielding at this point is very common, complete dislocation rarely happens, probably because the direction in which they run deviates so little from the straight line. In bad cases of knock-knee, the knee-cap lying in the tendon of the great extensor often slips to the outer side of the joint when the limb is straightened; and the same thing sometimes occurs during flexion, from defective development of the lower limb, associated with a peculiar kind of deformity; but neither of these can be fairly regarded as dislocation of a tendon due to injury

Biceps.—Whether the long tendon of the biceps can be displaced from the groove in which it lies seems still not quite certain. I have seen one case in which this peculiar injury was diagnosed, and although verification was not possible, I think there can be no doubt not only that the tendon did actually slip out of its bed, but that by twisting the arm round, which the patient could do by means of his other hand, it could be made to slip in and out again at pleasure. No snap could be heard, it is true, nor was there any distinct difference along the front of the arm when the two sides were compared together; but the inability to raise the arm from the side at one moment, and the comparatively free range of action after reduction had been effected, left little doubt that it was a genuine example. Passive motion was fairly good, as it was in the case described by Hamilton, only somewhat painful. There was no undue prominence on the front of the shoulder, possibly because of the recent date of the accident. The case, it is admitted, is incomplete, and as the patient was under my observation only a short time, I cannot give any account of the subsequent progress. It does not agree in all respects with those recorded; but as Hamilton has shown by actual dissection the possibility of such an accident, and as I cannot understand what other displacement in the region of the shoulder could have produced so peculiar a train of symptoms, sometimes well marked and definite, and then all of a sudden disappearing for a time, I think it must be allowed. In old cases of rheumatic gout it is not at all uncommon to find the groove filled up, and the tendon flattened out over some ad-

jacent part of the head of the bone, but there was no evidence of disease in the present instance.

Ruptured Veins.—The presence of varicose veins is often a serious matter when the ankle joint is sprained, particularly in the case of a person who is advanced in life; and in this respect minute vessels, which give rise merely to a mottled bluish appearance of the skin, are, perhaps, more to be apprehended than when one or two of the larger trunks only are involved. The actual amount of blood lost may not be so great, but the tissues do not seem so well nourished, and absorption is much more slow. It must not be forgotten either that the deep intermuscular veins are often as much dilated as the more superficial ones, and that when they give way a very large quantity of blood may be effused into the deeper strata of a limb before making its appearance on the surface. The inconvenience that results from this is very serious, and convalescence is much protracted; for until the whole of the blood thus effused is absorbed the muscles do not recover their freedom of action, or the subcutaneous tissues their normal supple feel. Rigidity and œdema, worse when any exertion is made, may persist for months solely owing to this.

Injury to Bones.—This even does not exhaust the list of structures that may be injured. The bones themselves are frequently bruised, especially when, either from delicacy of constitution or other causes, such as disease, their substance is soft and vascular with an undue amount of fat in their composition. It is true these injuries are not often demonstrated, though I have sometimes found dark stains, due to hæmorrhage, deep in their substance; but inflammation is sufficiently common to make it unreasonable to doubt that they too meet with their share of damage. Diseases of the spine, hip, and other joints in children may be due, in great measure, to some constitutional taint, though it is open to question whether the influence of this is not overrated; but it is quite certain that the immediate starting-point in nine cases out of ten is some chance sprain, often so slight as scarcely to have been noticed at the time.

CHAPTER V.

INFLAMMATION AND THE PROCESS OF REPAIR.

The changes that take place in the tissues after the immediate effects of the injury have disappeared cannot be allowed to pass without some degree of notice. It is true that there is little that is special or peculiar about them; they are in nearly all respects identical with those that follow fractures or other injuries; but, for some reason or other, it is the popular impression, one that is shared, too, by not a few medical men, that these accidents are almost invariably followed by acute inflammation. Imperfect recovery is, I admit, exceedingly common; it is the frequency of it which makes sprains so serious; but, rightly or wrongly, inflammation is nearly always regarded as the cause. If it is the case, it is only reasonable that it should be allowed a certain amount of influence on the kind of treatment adopted.

At first sight, I am bound to confess, much apparently may be said in favor of this opinion. There is nearly always present in these cases a cavity of some kind or other, whether it is a joint, sac, bursa, or tendon sheath; and this is certain to be distended under considerable pressure by blood or lymph, which, unless active measures are taken, is very slowly removed by absorption. The quantity that may collect in a few minutes is enormous; I have on many occasions seen the wrist double the circumference of its fellow within half an hour of an accident. Naturally the degree of tension is very considerable; the sensory nerves are stretched or compressed; the part begins to throb; the skin becomes hot and red; and, to all appearance, there is the commencement of an attack of acute inflammation.

Now, there is no question that if this is allowed to continue unchecked it is very likely to be followed by this result; but if due and proper precautions are taken against it there need

not be the least fear. When inflammation breaks out, it is either the consequence of neglect, maltreatment, or some peculiarity of constitution, such as gout or struma, so marked that the least accident is sufficient to precipitate an attack. The changes that take place in the tissues after sprains are merely those necessary for the repair of the damage; it is only when they are encouraged beyond measure by other causes that inflammation is likely to break out.

Hyperæmia and Softening.—As soon as the bleeding is checked the vessels all through the injured area dilate, and their walls become relaxed and softened. The volume of blood circulating through the part is immensely increased; a much larger amount of liquid plasma pours out through the walls into the tissues round, mixing with the blood that has already been extravasated. All the interstices are filled with it, and become distended more and more, until the joint swells up and the skin becomes tense and shining from the way in which it is stretched. The different tissues are affected, of course, in different degrees; the capsule itself, owing to its delicate construction, very soon becomes thickened and softened; the loose tissue round it is affected even more quickly; the ligaments, from the way in which their fibres lie close set against each other, resist much longer; but they, too, at length, if the process continues unchecked, undergo a similar change, so that the softening and distention become general.

Effusion and Distention.—The fluid pours at once into any natural spaces, such as tendon sheaths or bursæ, that may be present. These and the synovial sacs of joints are the first to become distended, so that for some time the shape of the swelling follows distantly the natural contour of the part. Later, when the connective tissue round becomes softened and the swelling more general, this is lost, and the outline is rounded and uniform. At this stage the skin may be whiter than natural, though the temperature when the hand is laid upon it is higher than that of the corresponding point of the opposite limb; the superficial parts are so tensely stretched that the blood-vessels are emptied by the pressure, but the sensation of warmth is still transmitted from below.

Very little of this, of course, is to be seen post-mortem. No hyperæmia can be found then, no matter how great it was during life. It disappears with the vitality of the part, and

its extent and degree can only be conjectured from the few signs it leaves behind. Minute extravasations may be found here and there, especially among the softer parts; and the fluid in the cavities may be stained with blood in different degrees, or, it may be, turbid from shreds, and flakes of fibrin or mucus floating in it; but apart from the actual lacerations, nothing further can be seen in the earliest stages.

At a later period the changes are better marked. The smooth glistening polish on the inner lining of the joint is gone; in its place there is a dull and lustreless surface, stained and discolored by the blood, and coated over with a deposit similar to that which makes the fluid in the interior turbid. In recent cases this may be washed off; after a time it appears to be incorporated with the wall itself. The two cannot be separated, and if a small portion is removed and examined under water, a number of little gelatinous processes float up from the surface, so that it looks something like a piece of coarse velvet. This is particularly marked over the softer parts of the capsule, where the synovial membrane is thrown into folds, or where masses of delicate and vascular connective tissue project into the interior for the pupose of filling up the irregularities between the bones. On the other hand, where the ligaments directly bound the cavity, merely covered by a layer of cells, with no soft intervening stratum, hardly any such change is to be seen. So it is with the cartilage that covers the bones; it scarcely shows a trace; even the blood stains cannot penetrate beneath the surface.

Organization.—The softer and looser the tissue the greater the effect. Round the edge of the joints, so to speak, outside the line of pressure, where the fibrous capsule is attached to the bones, and where the synovial membrane lies folded on itself, and, as age advances, becomes covered over with fringes and villous processes, the bruising and softening are most conspicuous. It is not the surface, or the lining membrane only, that shows the change; the whole thickness of the capsule is affected, and where it is thin and delicate, or where, owing to the shape of the bones, there are hollow spaces round on which pressure never falls, the tissues outside suffer too. In more than one example I have seen this extend long distances by the side of the bones; and it is, I believe, in great measure owing to this that many sprains, apparently trivial

at the outset, are followed by such impairment of mobility. Unless measures are taken to prevent it, the whole of the fibrous structures at this part, the folds of the synovial membrane, the capsule, and the loose tissue outside it, appear to be lost in a soft, gelatinous mass of lymph, in which a few fibres here and there can still be found. If the joint is allowed to remain unmoved this fills up the entire hollow between the bones. Then, after the effect of the injury has passed off, when the hyperæmic stage is becoming less marked and repair is carried on more actively, it becomes organized, and converted into dense, unyielding, fibrous tissue, which ties the bones together, and to a great extent cripples the joint. It is not the fault of the synovial membrane alone, or the capsule, or the soft and loose connective tissue on the outside; they all play their part, though the share each of them takes may show a certain degree of difference in different cases.

In Joints.—In the shoulder, for example, stiffness of this description is of common occurrence, and may lead to serious inconvenience. At the lower and inner part of the joint the capsule is very thin, and has round it a large amount of loose fibrous tissue, so soft and delicate that it is thrown into folds when the arm is hanging by the side. No pressure falls on it so long as the limb is in the natural position; as it is raised from the side the folds are gradually straightened out, until they are put upon the stretch by the pressure of the head of the bone. Now, when the joint is sprained or hurt, this part of the capsule, owing to its softness and vascularity, is exceedingly likely to be injured; and unless active measures are taken to prevent it, the whole of it is very easily converted, first into a mass of soft, vascular lymph, and then into dense and unyielding fibrous tissue. There is nothing to prevent it. There is no pressure to close the vessels and limit the amount of lymph thrown out, or to help on the process of absorption; the folds are never opened out or separated from each other; if the joint is in the least degree painful it is kept at perfect rest, owing to the presence of others close by ready to undertake its work, and all the time without the patient being aware of it. When he is directed to raise his arm sideways from the body, he imagines he is using his shoulder joint, while, as a matter of fact, the whole of the action is being carried out by others; and this goes on until, by degrees, organization com-

mences, and the part quietly becomes stiff and rigid. The surfaces of the folds become adherent to each other, and incorporated with the tissue round; and instead of a soft and flexible capsule, there is a mass of shortened, rigid, and unyielding fibrous tissue, matting everything together, and not only by its strength preventing proper movement of the bones, but, by the pain it causes when any attempt is made, preventing any vigor being thrown into it.

Between Muscles.—Similar changes take place in the planes of the soft, cellular tissues that surround muscles, lying between them and other structures. The blood, escaping into these from the torn vessels, makes its way along the line of least resistance until it reaches some part where there is no pressure or movement. Here it remains, passive and unchanged, for a considerable period; but at length it slowly becomes organized, and by gluing together the different strata, gives rise to the stiffness and loss of power that are so common after severe muscular strains.

In Bursæ.—The effect produced by large bursæ has been already mentioned in speaking of joints. Many of them are merely open spaces in the connective tissue, lined by a single layer of cells, and, in ordinary circumstances, contain merely sufficient fluid to enable one surface to glide freely and smoothly on another. In reality they are formed, as required, out of the intercellular and interfibrillar spaces that exist everywhere in connective tissue. After sprains they act as receptacles for blood and lymph, and often become immensely distended. If the fluid is quickly absorbed again there is no ill result; the walls contract, and the cavity resumes its former size and shape; but if there is any delay when at length absorption does take place, the softened and relaxed walls are thrown into folds, so that the sides grow together and become incorporated with each other. Instead of there being a thin-walled sac, assisting every movement by diminishing friction, there is a rigid mass of tissue, stiffened, irregularly thickened, and adhering to everything round it, the seat of constant pain and tenderness. When this change is established, restoration is much delayed. The progress at first is often rapid, the later stages are sure to lag behind; and the longer the thickening and infiltration of the tissues have lasted, the greater difficulty there is in getting rid of them.

Inflammation.—These changes are not due to inflammation. Pilcher, in describing the consequences of sprains affecting the wrist joint, has shown the difference between them with admirable clearness. It is perfectly true that the parts are swollen from the extravasation of blood, and the effusion of lymph; that the skin is sometimes reddened, and the temperature raised, owing to the increased amount of blood circulating in the vessels of the injured area; and that there is tenderness and pain, partly because the nerves are torn across, partly because the sensitiveness of the skin is heightened; but this, though it may end in it, does not make up inflammation.

The increase in the flow of blood is the natural outcome of the injury. A certain amount of repair is always being carried on, in correspondence with the ordinary wear and tear of everyday life. At times, from accidents or other causes, this work undergoes an immense increase; then, in accordance with the physiological laws which control all parts of the body, a much larger amount of blood flows through the part, and a greater quantity of reparative lymph is poured into it.

So long as the skin remains unbroken, it is altogether unusual for injured parts to become inflamed. Except under such circumstances as blood-poisoning (when any injury leads to abscess), or where from some accidental cause, such as the rupture of a large artery, a high degree of tension is set up in the tissues, inflammation following a subcutaneous injury is the exception, not the rule. Fractured bones, when the skin is unbroken, hardly ever excite inflammation; contusions and bruises may more often, because it is more common in them to meet with tension from fluid that is allowed to accumulate; sprains form no exception. Inflammation may set in from maltreatment or neglect; from peculiar conditions of the blood (such as gout or rheumatism) in which inflammation of joints sometimes occurs without any injury at all; or if a large amount of blood is allowed to accumulate, just as it sometimes does after a bruise; but under ordinary conditions it is not a necessary consequence, and may nearly always be prevented.

This is of material importance in the question of treatment. As regards the time at which this should be commenced, most people are agreed; and the methods adopted for the earliest stage have (most of them) something to be said on their behalf; but when the second stage is reached, as Pilcher, Hood,

and many others have pointed out, the mistaken notion of inflammation being a necessary consequence, has given rise to a plan which is not only directly opposed to all that is rational, but which, as might be expected of anything of which such a statement can be made, is to be regarded as the immediate cause of many of the troubles of later times. Small blood-vessels are always torn across when such accidents happen; sometimes the number is considerable; a certain amount of extravasation necessarily follows; this must be absorbed, and the injured tissues repaired or replaced, before the part can be said to have recovered, but it is always effected by perfectly natural means. The amount of blood that circulates through the part, and the quantity of lymph that is poured into the tissues, are increased in proportion to the work that has to be done. The softening of the intercellular substance is to facilitate this. It is only when the process passes beyond what is needed for the purpose, and becomes continuous and progressive, that it deserves the name of inflammation.

It does not do, however, on this account to run to the other extreme, and declare that inflammation never occurs. If a large amount of blood escapes from the vessels into the tissues, or if from using the joint too freely or too soon after it has been hurt, the hyperæmia is not allowed to subside, it is almost certain to do so. Anything that causes a high degree of tension is sufficient to induce it; the part begins to throb; the temperature rises; the swelling increases more and more until it may declare itself at any moment. It is more likely to break out in certain constitutions, and in certain joints; but if any synovial sac, or bursal space, is allowed to become distended, it follows as naturally as it does elsewhere. Only, so long as the amount of effusion is confined within due limits, so that the tissues can deal with it with a little assistance, without being overtaxed, inflammation is the exception, always provided there is no constitutional predisposition to bring it on.

Absorption.—These are the changes that take place in one direction. Side by side with them, commencing more slowly, it is true, but steadily progressing until it gains upon, and finally overtakes them, is the process of absorption. The sooner it begins, and the greater the activity with which it is carried on, the better the prospect of speedy recovery. When

it is incomplete, the consequences are always serious. As already mentioned, inflammation may set in and end in grave disease; the synovial cavity of the joint may continue distended with fluid until the capsule loses its elasticity and cannot contract again; the ligaments may be stretched and softened; there may be hard, unyielding masses of old blood clot lying among the tissues, and causing pain by pressing upon the nerves; or bands of lymph, converted into fibrous tissue, may pass from one bone to the other across the joint, making it stiff and rigid, and preventing free movement. Sometimes (after a sprained ankle, for instance) the soft tissues behind the bony prominences remain swollen and puffy for years, getting better from time to time, and then, again, especially of an evening or after any exertion, swelling up more than ever. At others, the nutrition of the part does not recover, and it remains cold and stiff, with a look of utter helplessness about it. Whenever, in short, recovery after a sprain is incomplete, and no actual displacement or other gross lesion can be found to account for it, the real fault is that absorption has never been thoroughly carried out, and that the circulation is not restored. The perfect recovery after these injuries is, however, of so much importance, and is so intimately bound up with the question of treatment, that it must be dealt with by itself.

The track of the extravasated blood, as it is absorbed, is easily made out. The red blood corpuscles break down, and are destroyed; their coloring matter dissolves in the fluid, and soaks into the tissues along the easiest routes, marking its path by the staining of the skin. The distance this spreads, and the length of time it lasts, may give some idea of the slowness with which absorption is carried on, even when the area is extensive. It is no uncommon thing for the bruising of a sprained ankle to reach the knee; and it may be many weeks before the last trace has vanished. Even then it disappears from the connective tissue interspaces outside the joint more rapidly than it does from the synovial sac within, or the bursæ and tendon sheaths round. In the one case it is widely diffused among the fibres, lying actually in the little interstitial spaces, out of which the absorbent vessels spring; in the other it occupies a cavity, only part of the wall of which possesses any absorbing power, and that not in a very high degree. Sometimes, owing to this, a few days after a sprain,

the joint appears larger in proportion to the parts round than it did shortly after the injury.

Gradually the semi-fluid material between the cells and fibres diminishes in amount, and becomes firmer in consistence; the surplus lymph, not needed for the repair of the tissues, is carried off, taking with it the remaining *débris* of the red blood corpuscles; and the nutritive plasma circulates again in normal amount, and at its normal rate, through the tissues.

Effects of Pressure.—It is worth noting how immensely these changes are assisted by the judicious use of compression. The extravasated blood betrays its presence everywhere by the stains upon the skin. In nearly every case it follows definite directions, being guided along certain strata either by the arrangement of the stronger sheets of fibrous tissue which surround and separate groups of muscles, or else by pressure applied from the outside. Where the bones lie immediately under the surface, so that the skin and subcutaneous tissues are firmly compressed when a bandage is applied, the color remains white and unstained. In the hollows between the bones, or behind eminences, which protect the soft parts, the tissues are swollen and puffed out, and may be jet black for a time. So it is with the effusion of lymph at a later period; only owing to there being here no alteration of color, the signs are not so conspicuous. The swelling always disappears first from those parts on which the pressure falls; it persists longest in just those places where it effects most mischief, in the little irregular hollows that lie between the bones, especially, as has been mentioned already, in the case of the shoulder, on the side where the tissues are softest and most yielding.

As the tissues shrink to their former size, the lining membrane of the joint cavity slowly resumes its natural appearance. Granulations cease to form on the inner surface; the latest formed cells, instead of dropping off into the fluid, become firmer and flatter, and are held together better by the cementing substance, so that they reproduce the glistening surface of the synovial lining. The fluid becomes more clear again, and its normal color and consistence return, though the quantity may continue excessive for a very considerable time.

Permanent Changes.—The fringes, and the tissues at their base, retain their altered character the longest. Often, indeed, they never quite regain their former size or texture. They

become firm and hard, and more opaque from the organization of lymph in their substance. Sometimes the larger ones become vascular, a loop of blood-vessels growing down into them from the base; and then they are practically permanent. If a joint has been sprained more than once, their presence can nearly always be detected in certain favorite localities, as, for example, on either side of the knee-cap. Owing to the synovial membrane being so superficial here they can be felt quite distinctly, even when they are still small, rolling between the finger and the bone. So long as they remain small they scarcely give rise to a sensation of inconvenience, but when they reach any size they act to all intents and purposes as so many fixed foreign bodies. Owing to their position, well out of the way of the bones, they do not often get caught between them, or they would prove a grave source of danger; but even though they escape this, they keep up a continuous if slight amount of irritation; the hyperæmia and effusion never quite disappear; the capsule and the ligaments become involved more and more, and the strength and security of the joint at length are seriously impaired.

Length of Time.—Where ligaments have been torn, whether they are completely separated in two, or, what is more usual, have merely sustained a number of small lacerations in their substance, it is, of course, a matter of some considerable time before perfect repair can be effected. So it is when muscles or tendons are torn, or if the sheath in which they lie is widely rent; and above all, if, before the parts are firmly united another undue strain falls on them. When this occurs, not only is the whole of the original mischief reproduced, but the degree is, generally speaking, more severe: for, owing to the vascularity and softness of the part at the time, the hæmorrhage and laceration are nearly always more extensive than they were at first.

It is impossible to lay down any precise rule as to the length of time required for the repair of these more serious hurts. Each case must be judged on its own merits. The amount of injury, not merely that sustained at the moment, but the subsequent damage often inflicted in ill-advised attempts at treatment; the kind of tissue that has suffered most; the extent of the extravasation; the particular kind of joint, whether in the upper or the lower limb; the age, and above all, the constitu-

tion of the patient; the care he will take of himself; all these things have to be considered with many others before an estimate can be given. All that can be said is that a severe sprain, tearing a strong ligament, or wrenching it from the bone, takes quite as long before union is perfect as a fracture through the bone near it. The patient may be able, probably will be able, to make limited use of the limb much earlier, especially if he is careful to avoid any movement calculated to throw a strain on the injured part (which, of course, in the case of a fracture is rarely possible); but recovery takes at least as long, and perfect convalescence, with perfect movement, often much longer.

CHAPTER VI.

IMPERFECT RECOVERY.

One of the most annoying things in connection with sprains is the frequency with which they improve up to a certain point and then come to an abrupt standstill. It is not merely that convalescence is protracted, it is delayed so long that it becomes a question if the joint is ever to recover. For the first few days, perhaps, everything progresses as well as it possibly can. The patient is wise enough to recognize the situation, and to reconcile himself to the necessary confinement, though this, as only those who have suffered themselves know, is very often far from being an easy matter. The dread of inflammation passes off, the swelling begins to diminish, the color of the skin changes from black and purple to green and yellow, the tender points can be touched again, and a certain range of movement is permitted once more, though in a tentative and cautious manner. With moderate good fortune this continues, until at the end of two or three weeks the injury is repaired, and the joint as sound and as trustworthy as it was before. Very often, however, it happens, as time goes on, that the improvement becomes more and more slow, until, perhaps, it comes to an end altogether, and the joint is left stiff, painful, it may be, and almost useless. The tissues seem to have been repaired, but freedom of movement does not return.

The extent to which this suffers differs very considerably. As has been mentioned already, the joint may be merely a little weak and unsteady, not quite to be relied on, perhaps, when called upon for any special effort; or it may be so stiff and rigid as to give rise to the suspicion that the bones are grown together, and the cavity completely obliterated. It may be perfectly free from all uneasiness in ordinary circumstances, or it may be the seat of constant aching, with frequent sharp twinges of rheumatic pain. In many cases it may be moved without inconvenience up to a certain point, but the

least attempt to carry it beyond this is stopped at once by pain, and a sense of resistance. Yet, in spite of this, the skin may be quite cool, and the tissues of the joint, to all appearance, perfectly sound. Sometimes, in cases such as these, it is possible to find a definite reason; a tendon may be displaced and have been overlooked, or one of the internal portions thrown out of gear; secondary changes, such as wasting or spasmodic rigidity, may have made their appearance in the muscles; or the capsule may be so relaxed that it is unable to maintain the necessary degree of pressure on its contents; but such as these, for this reason, must be dealt with by themselves. Those to which I wish to refer at present are altogether different; no definite lesion is to be found in them; they do not seem to have been severely injured; there is no evidence that the amount of laceration was extensive; yet they remain so stiff and painful as to be almost useless, without any apparent cause.

The severity of the sprain has nothing to do with it. It is quite as common after slight injuries as after severe ones. Indeed, it very rarely follows complete dislocations, in which the laceration is most extensive of all. It may even come on without injury if the joint has been inflamed; no matter how slight the attack, it sometimes leaves behind it a degree of stiffness that lasts for years, long after all trace of the exciting cause has passed, and without there being any gross change to explain it.

General Appearance.—There are certain features about these joints by which they may usually be recognized. If it is a superficial one, like the knee, the skin is reddened, but not with the bright flush of inflammation, or the ruddy glow of use; it is dusky and bluish, and if the finger is pressed upon it so as to drive the color out it is very slow in returning. Often it is cold to the touch; the patient may declare that it feels warmer than the rest of the limb, and even complain of a constant burning pain, but as tested with the hand, or, better still, with a surface thermometer, it is decidedly cooler. Sometimes the skin is smooth and gloosy, sometimes wrinkled, but it does not fall into the natural folds of the part, or glide evenly over the bony prominences beneath. It seems too tight, as if it were shrunken, and it cannot be pinched up, or made to glide from side to side Frequently one or two spots are exquisitely

tender, not merely when firmly pressed upon, but even if a finger touches the

The tissues round are wasted; the shape of the bones stands out too distinctly; the hollows are not filled in by muscles or by fat as they are in normal health. Even in joints so well covered as the hip and shoulder something of this can generally be made out by the eye, though measurements may fail. Occasionally, however, this is concealed by the swelling of the subcutaneous tissue round, especially in the case of the ankle joint, if the leg has been allowed to hang down for any time before it is examined.

Impairment of Mobility.—The most prominent feature, however, in connection with these joints is the interference with their movement. The limb in most may be bent more easily than it can be straightened; but it is seldom that it can be moved to its full extent in either direction. It is stopped abruptly as soon as a particular angle is reached; the check is so sudden and so firm that the bones seem locked together, and any attempt to force it further only causes intense pain shooting through the joint, often most severe where the skin is so tender to the touch. Generally, though there is a sense of discomfort and apprehension the joint can be moved up to this point without much distress, but occasionally even this is not possible. The pain is so severe, and the dread so great, that before the part is touched the muscles contract and hold it rigid, almost in spite of the patients' will. It is literally beyond their power to allow the movement to take place; the pain is to them so intense that their will is overcome and control over their actions lost

Muscular Rigidity.—In these cases it is impossible to form an opinion without anæsthetics. When the muscles are relaxed so that their action is eliminated from the question altogether, and there is no longer any fear of causing pain, the part may be examined thoroughly, and it is easy to ascertain whether the check is entirely the result of muscular rigidity or whether there is some other obstacle in addition. Such cases are not uncommon. Brodhurst mentions one in which the joint was so stiff and motionless as to give rise to the suspicion that the bones had actually grown together; when the patient was under an anæsthetic, movement was almost as free as it is naturally.

It is true that a good deal of information may be gained, especially in children, by diverting the patient's attention from the part, and carefully manipulating it at the same time. When this can be done, it is often discovered that the actual range of movement is a great deal wider than it appeared to be; but, in the first place, this is not always possible; and then, though the information is undoubtedly of very great service, it is never quite enough. It shows beyond question that the rigidity is due in some degree to muscular contraction; but it entirely fails to show how much. It is only possible to make certain of this when the muscles are in some way completely relaxed, so that they no longer enter into the question.

Creaking.—Creaking or grating, as the surfaces move on each other, is always present in these joints. It may be but the faintest sensation of friction, only to be perceived by pressing the hand firmly on the part, as if two smooth silken surfaces were being rubbed together; or the noise produced as the fluid is squeezed from one side of the joint to the other may be distinctly audible to those around. This, of course, depends on the condition of the lining membrane of the cavity, whether it has merely lost the polish from its surface or is covered over with folds and fringes, which project from all round the margin into the interior.

Bands and Adhesions.—It is a matter of popular belief that there is in these joints a band of some kind, passing across the cavity from one side to the other, independently of the lining membrane. When at rest this is quite loose; as the limb moves it suddenly becomes tense, and stops it abruptly, causing very severe pain by the way in which it is stretched. It is possible, of course, that a structure of this kind is developed sometimes; but I have never found such a one myself in a joint, nor am I aware of any case in which such a phenomenon has been recorded. Its presence would undoubtedly furnish a very simple explanation of symptoms that are often obscure; but it possesses the objection of being almost too simple. It explains all the facts at once, in such a plain and straightforward manner, that in the absence of all corroborative proof, one cannot but feel a certain degree of scepticism and reluctance in accepting it.

At the same time it cannot be denied that the evidence on which this opinion is based is very striking, and is sadly in

want of an explanation. A joint has been sprained some long time before, and for years has remained painful, and, comparatively speaking, useless; it has been rested, and bandaged, and blistered over and over again without the least benefit; any attempt to move it is stopped at once by the pain; every time it is tried it becomes swollen, hot, and tender; and apparently drifts down into a worse condition than it was before. All of a sudden, something gives way, perhaps with an audible snap; there is a moment's intense pain; but movement is regained, and recovery is perfect from that instant, without after trouble or ill consquence of any kind.

A good many cases such as this have been recorded from time to time, among others by medical men, from their own personal experience. Sometimes they have been cured by a designed plan of manipulation, sometimes by an accidental fall. There is, however, a certain amount of suspicion that they are not quite so common as is generally believed, for it is in the nature of people to spread abroad as widely as they can everything that savors of the marvellous. I have myself met with very few that could be called in any way typical, though, of course, instances of joint disease, in which great improvement has resulted from vigorous passive motion, are common enough. One instance was very characteristic. The patient was a strong, healthy man on active service, who had been invalided home owing to the condition of his knee. (I may remark that a very large proportion of the more striking cases occur in connection with this joint.) He had sprained it severely some months before in a fall from his horse, and as it was considerable time before anything could be done for him the swelling became enormous. Then it was kept absolutely quiet in a straight position for three weeks. Cold was applied, but not compression. At the end of that time the joint was exceedingly stiff and painful, but still he managed to get about upon it, and it improved gradually, up to a certain point. It could be straightened out fairly well, but could only be bent through about twenty degrees; as soon as this angle was reached it came to a dead stop, and any attempt to carry it further only caused the most intense pain and made the swelling worse. At the time that I saw him he was so disabled that he was only able to go upstairs with difficulty. The joint was very slightly swollen; so far as could be detected nothing

was out of place. All that could be found was a very tender spot on the inner side of the knee-cap, where the pain was always most intense. Circumstances at the time rendered it unadvisable that an anæsthetic should be administered, and a few days after he was completely cured by an accident. Coming downstairs he tripped suddenly, throwing involuntarily the whole of his weight on the affected limb, felt something snap, and fainted away from the pain. When he recovered the joint was a little tender over the old spot, but it could be moved as freely as the other. There was no increase in the amount of the swelling, and the pain was gone, nor did it return. (Strange cures of this description are not limited to sprains, as the following extract shows:—"Persons given to meditation must often have found ample material for speculation in endeavoring to imagine what train of thought could have prompted the introduction of certain surgical procedures, or led to the first trial of this or that therapeutical agent in the treatment of a particular disease. What, for example, could have stimulated the first idea of curing sciatica by stretching the sciatic nerve; certainly the task of finding a train of thought which should conduct to that conclusion would be a severe one. Many such methods have doubtless been suggested by a real or fancied analogy between them and certain natural accidental occurrences, and in this sort of observation charlatans in all ages have shown themselves singularly apt. We may quote a couple of instances of recent occurrence, where the cure was effected under circumstances which must have suggested to bone-shakers their violent and unscientific, but occasionally successful manipulations. In one case the person had been almost bedridden for many weeks from sciatica; still suffering acutely from the attack, but a trifle less in pain, he hobbled forth to get the benefit of a little fresh air; at a crossing he was roughly pushed by a passing vehicle, and after a desperate but unavailing effort to preserve his equilibrium he fell on the road in the midst of a fairly dense traffic. It was only when he had regained the sidewalk that he began to feel astonishment at the, in him, remarkable agility shown in jumping up and running to a place of safety. The sciatica had quite disappeared, and had not returned four years later. In case number two a strain had been followed by severe pain on movement over the outer condyle of the right elbow, which

lasted for several months, almost incapacitating the sufferer from pursuing his occupation as a hairdresser. There was no obvious lesion, but no treatment was attended with any benefit. One night, on leaving work, he had to find his way along a dark passage, in which the cellar door had inadvertently been left open. Against this he struck himself violently on the painful spot, giving rise to such pain that he nearly fainted. Within a day or two, however, as the effects of the bruise disappeared, the other pain was now noticed to be absent. The facts are rather curious, although it must be confessed it is not easy to see how to formulate any practical rules of treatment as a deduction therefrom.")

It certainly seems possible that in this case a band was developed in connection with the joint during the long period of repose, but I am not prepared to assert that it was in the interior of the sac. The tissues were very much swollen for a long time after the accident; the joint was never moved; a great deal of effusion was thrown out; the soft folds that exist round the knee-cap were immensely thickened, so that it is possible they gradually formed a connection along the interior of the capsule with those of the opposite side; as organization proceeded the union gradually increased in strength, until it was firm enough to check the movement of the joint: straining on it caused severe pain by the way it dragged upon the softer tissues; the sudden violent jerk tore it in two, and restored free movement. But it must be admitted that this does not rest on any direct or certain evidence.

Changes in the Tissues.—Opportunities for examining the interior of these joints must, from the very nature of things, be quite exceptional; and the difficulty of explaining the symptoms is not diminished by the fact that when one does occur the result is not always unequivocal. In a large proportion there is nothing to be found post-mortem; the structures appear as sound and as healthy as could be wished; and even where there is something definitely wrong, it is often so slight that it is impossible to believe symptoms of such intensity could be due to it alone. Clearly, the conditions upon which they depend must, in the majority of cases, be such that they come to an end, and disappear with the life of the part. Nor is it difficult to imagine of what sort and kind they must be. Changes in the circulation or nutrition of the tissues, for ex-

ample, often leave no trace behind, and yet may cause the most serious interference with the way in which the work is carried out. It is quite enough if the part is imperfectly supplied with blood so that the muscles are overloaded with waste products, and the nerves enfeebled and unable to play their part with sufficient energy. There need be no actual change apparent to our present methods of investigation; the tissues may be merely stiffened from disuse and badly nourished, unable to move freely, or accommodate themselves to each other; there is no need of more, it is quite sufficient, without having to invoke the aid of conspicuous alterations in structure.

The Interior of the Joint.—Sometimes there is an excess of fluid in the interior; more often, especially if the joint has been kept at rest for long, the quantity is diminished, and it is nearly always thin and serous in character, a little turbid, and not so oily as it should be. The cartilages are never much affected, the part they play is too passive, only in old and long-standing cases they lose the glistening polish from their surface, and are a little thinned. The capsule, with the loose tissue round, as a rule, shows more; instead of being soft and flexible, so that it falls into folds as the joint moves in one direction, and opens out again as it moves in the other, it is stiff and unyielding. In other cases it is irregularly thickened, with its inner surface marked by folds and ridges, in which are little elevations of the lining membrane; or at the point where it is attached to the bone, and the fibres diverge somewhat from each other, there is an accumulation of lymph holding them together, and as it becomes organized making one part drag unfairly and unevenly on the rest; or, again, there is an old extravasation of blood, the remains of some larger quantity, of which part has never been reabsorbed.

Old Extravasations in the Wall.—In one case, at least, I think I could attribute the whole of the symptoms to a cause of this kind. The patient was a man of more than middle age, who came to me complaining of an exceedingly painful and tender spot over the inner side of the knee joint, about half an inch from the margin of the knee-cap. There was a history of his having struck the joint against a sharp piece of furniture on this particular spot some weeks before. The skin itself was freely movable, but appeared slightly raised and puffy; there was no dislocation at the time that I saw him, and it

was doubtful if there had been any—at least, the patient had not noticed it. The pain on touching it was intense; steady pressure could hardly be borne at first, but seemed to relieve it afterward; walking, particularly going upstairs, and setting the extensor muscle of the leg in action, were both very painful. With the joint itself there seemed to be nothing wrong; there was no appreciable excess of fluid, and the tender spot was so fixed, that, almost certainly, it had nothing to do with the formation of any fringes or foreign bodies in the interior. The suggestion was that either some of the fibres of the muscle inserted into the capsule had given way, or that there had been a small hæmorrhage into the substance of the capsule itself. I had the opportunity of examining the joint at a later period, and was able to verify the diagnosis; so far as I could ascertain the muscular fibres were intact; in the substance of the synovial membrane, corresponding to the painful spot, there was a small hard mass projecting further into the cavity than it did on the exterior, probably because there was least resistance in this direction. It seemed to be the residue of an old extravasation; the blood had been effused between the fibres of the capsule; some of it had been absorbed; the rest, owing to the protection it received from the side of the knee-cap, escaping all pressure, had become organized and formed a small hard nodule. Probably this happens in many cases without material consequence; most likely in this particular one it implicated in some way or other a nerve filament, and, like the little peculiar tumors known as painful subcutaneous tubercles, when it was touched it dragged or pressed on the nerve and gave rise to stabs of acute pain.

Dry Synovitis.—Barwell has described under the name of dry synovitis, another condition which may exist in some of these cases, and help, in a measure, to account for the symptoms. There is, according to him, a deposit of fibrinous material on the inner surface of certain parts of the lining membrane, probably derived from the fluid which collects in the joint when it is inflamed. During life these spots are so painful that the patient will hardly allow them to be touched, and can scarcely be persuaded to move the limb. Sometimes the pain is paroxysmal, and often periodic in character, and it is always severe to a degree which bears no comparison with that of ordinary synovitis.

Neuralgia.—Occasionally the pain and loss of power are caused by a kind of neuralgia, which attacks joints and seriously interferes with their freedom of action, without leaving behind any visible evidence of its existence. These may be recognized by the peculiar periodic character of the pain, and by the way in which it is limited to certain spots, which correspond fairly well to the places where the nerves penetrate the fibrous capsule. The skin immediately over them is exquisitely tender to the touch, and sometimes puffy, or slightly swollen; and movement is limited, because, as the joint bends, the capsule is exposed to different degrees of tension, and in certain positions the affected nerve is pressed upon or stretched. The check, however, in these is rarely so abrupt as it is in the others. In one case under my care it appeared to alternate with supraorbital neuralgia, the pain sometimes occurring in one locality, sometimes in the other, but scarcely ever being present in both at the same time. The patient, who was thoroughly overworked, was readily cured by rest and change of scene.

Tissue Starvation.—In a large number, however, this explanation fails as well. There is no evidence of neuralgia; there is no gross lesion to be detected anywhere; no increased effusion, thickening, or adhesion; the tissues simply are wasted; the muscles have lost their power, and the joint is so stiff and painful that it is almost useless. The real reason is the prolonged want of use. The tissues are starved and badly nourished. During life they are surrounded and bathed in a nutritive fluid, which pours out through the walls of the vessels and permeates them in all directions. It spreads everywhere in the interstices, giving up to the structures with which it comes in contact the material they require for their growth and action, and taking away whatever is worn out. The surplus is drained off by a special system of vessels, the absorbents, so that it may never remain stagnant. The rapidity of its flow is entirely regulated by the activity of the tissues. If they are in constant use, a larger amount of blood comes to them; more of this plasma passes through the walls of the vessels into the spaces round; the supply of nutritive material is greater, and the waste more rapidly carried off. If, on the other hand, the part is kept in a condition of absolute repose, the plasma lies stagnant round and between the tissue ele-

ments, so that when they are suddenly called upon for active work they are unfitted and unable. Until the free current of the plasma is thoroughly re-established once more, recovery of power is impossible. When this is effected the parts regain their strength and vigor almost of themselves.

Even a healthy joint that is kept absolutely at rest may be so badly nourished that it becomes stiff and unfitted for work, especially if the demand is urgent or severe. If it has been injured or inflamed, so that there is a larger amount of waste and greater need for repair, and is then kept motionless, this result is almost certain to occur.

It is a common thing to call such joints as these hysterical, merely because there is no evidence of any gross or conspicuous lesion; nothing, for example, is out of place, and no band or adhesion can be detected. But it is more than doubtful how far this is correct. When a joint becomes stiff, and the muscles wasted because they have been disused and are not properly nourished, it ceases to be purely and simply hysterical. It is true this may have been the starting-point, because of this the joint may have been kept at rest or prevented from enjoying its full range and freedom of action; but when changes of this description have once made their appearance there is something above and beyond mere hysteria. There is a local affection which can only be cured by local measures, and which must be cured before the hysterical condition can disappear. So long as it persists the patient is convinced, and quite rightly convinced, that the joint cannot be used freely as it ought to be. It is quite true that it cannot, and until it has regained its freedom of action, and the muscles their strength, it is hopeless trying to convince the patient that it can. Happily in many instances the changes are so slight that the joint recovers if it is only used in a moderate degree; if, for example, under the influence of change of air, or change of interest, the patient's attention can be diverted from it. Often, however, this is not enough, and then measures must be taken, first to give back to the joint its complete range of movement, and then to restore the nutrition of its tissues so that they may regain their power and activity.

CHAPTER VII.

TREATMENT. COLD. HEAT. PRESSURE.

It must be admitted there is something very unsatisfactory in the results obtained by the ordinary methods of treatment. Even when the greatest care is taken, when every precaution is used, tedious convalescence is the rule, rapid and perfect recovery the exception, and often, owing to carelessness or delay, the joint never recovers at all. It is left weak or tender, not so trustworthy as it was; prone to swelling with the least exertion, and sensible to every change of weather, so that there is an end once and for all to the healthy unconsciousness that such a thing as a joint exists.

The reason is not far to seek. In a large proportion of cases the measures adopted are altogether insufficient; in some they are absolutely wrong, when, for example, a joint is kept perfectly quiet until it becomes hopelessly stiff; while in nearly all the time that is of the greatest value, that which immediately follows the accident, is allowed to pass by without anything being done, and completely wasted.

Whatever plan is adopted it is essential to begin at once. Every moment lost makes a serious difference. The injury is not confined to the instant of the accident. The blood keeps pouring out from the wounded vessels and accumulates in the synovial sac and the interstices of the tissues, until if left to itself it causes such an amount of pain and tension that inflammation is bound to follow. If recovery is to be speedy or sound this must be stopped at once, or, at any rate, confined within the narrowest limits. When once it has left the vessels, and become extravasated, it serves no useful purpose, whether it collects in the cavity of a joint or spreads itself through the loose tissues of the limb. It separates the ends of the torn ligaments; it distends the synovial sac until it becomes stretched out of all proportions, and when it is absorbed

it leaves the capsule loose and flaccid, so that the joint feels weak and powerless. If it remains, the consequences are worse still; either it breaks down and forms an abscess, or, as already described, becomes organized into a hard unyielding mass, which interferes with the action of the muscles and compresses the nerves so that free use of the limb is rendered impossible.

The first thing to be done then is to check the bleeding into the tissues, and to spread out over as large an area as possible the fluid that has escaped already. Then, as reaction sets in, as the part becomes warm and red, and as the quantity of blood circulating through the uninjured vessels begins to increase, steps must be taken to keep this well within bounds. There must be a certain increase; it is essential for repair; the injury entails more work; there is a larger quantity of worn-out material to be removed and replaced, and more blood is required for it. Only it must be kept strictly within limits, and not allowed to run on until the synovial sac and tendon sheaths become distended or inflammation itself sets in.

If this can be done little further is required. All that remains is to assist the circulation through the tissues in every way, to maintain the nutrition at its highest level, and by gentle passive motion prevent the limb becoming stiff. Repair takes place with very different rapidity in different people and in different ages, but ligaments that have given way, or that have sustained many small injuries in their substance, naturally cannot in any circumstances be repaired at once.

Cold.—When the matter is thought out there is something almost ludicrous, if such serious consequences did not follow, in the general way in which, as a matter of routine, a wet bandage is applied to a sprained ankle. For the moment it is cool and pleasant, and with the folds and turns lying evenly and smoothly on each other, looks exceedingly neat. The uniform pressure does give relief at first, but in a very few minutes the coolness disappears and the temperature is as high as that of the joint beneath. In a few more it begins to dry, and as it dries it becomes loose, so that the pressure (which never at any time falls quite in the right part) disappears altogether. If the bandage is removed and the limb examined it is smooth and round, with the hollows quite filled up. The bandage, of course, passes over them without pressing upon them, reserving this for the bony prominences which

do not require it. The soft tissues are swollen and œdematous, and the synovial sac and the tendon sheaths distended with fluid. Applying it again in the same fashion does no good, nor is it of any use keeping the bandage wet. The principle is correct, but the method of application altogether a failure. Neither the cold nor the pressure is applied effectually, and the result of this method of treatment may be seen in the fullness and swelling that persist round ankles for years after they have been sprained.

The fault is not that of the cold. This is one of the most useful and satisfactory applications known. It may be dry or moist; it does not matter how it is obtained. The limb may be surrounded with ice or cold spring water poured over it, or it may be immersed in the water, or any other method adopted that suggests itself at the moment. The important point is that it should be applied at once, and that the limb should not be allowed to recover its temperature until a more permanent application is ready. Used in this way, as a first agent, cold is simply invaluable. It is always at hand, any one can apply it, and it fulfills every indication. The blood-vessels contract at once, the skin becomes white, the bleeding is checked, the sensitiveness to pain is diminished, and the tendency to swelling very much lessened.

If, however, it is used in a hap-hazard sort of way, as it is under a wet bandage, if the limb is allowed to grow warm from time to time, the whole of the benefit is lost. Reaction follows as the effect passes off; the blood-vessels dilate again until their diameter is much larger than it was before. More blood flows through the skin and the adjacent parts; a larger quantity pours out where the vessels are torn; the temperature rises; the sensitiveness of the skin is increased; it begins to glow, and the patient becomes conscious that the joint is increasing in size. In reality more harm is done in this way than if the the part is left entirely to itself. In some people who are more than usually susceptible, it is enough to produce results of exactly the opposite character to those intended, and in the later stages of sprains, when the joint is cold and powerless, it is used in this way for this very purpose. The alternate action of cold and warmth is one of the most effectual measures known for stimulating the circulation through a part, and if employed soon after the infliction of such an injury as

a sprain, before the ends of the vessels have had time to close, certainly does more harm than good.

As a Temporary Application.—It is equally important that the application should not be continued too long. As an immediate and temporary expedient cold can scarcely be surpassed, but after a time a condition of passive congestion sets in. The nerves and the delicate muscular fibres on which the contraction of the vessels depends become paralyzed; the part becomes red and swollen, in great measure from the blood that lies stagnant in it; the skin is anæmic, shrunken, and rough from the upstanding papillæ; the amount of blood and lymph in the tissues is sufficient, but it is never changed; the vitality of the part is lowered; the nutritive changes on which repair depends are carried on more feebly, and if the process is continued may stop altogether, so that the part either actually perishes or is attacked by a low form of inflammation. Even when the effect falls far short of this, long-continued cold brings about a state of things in the tissues that is by no means favorable to the repair of injury.

Method of Application.—Cold may be applied in a multitude of ways, but as a rule the simpler the method the better. It may be dry or moist. In the former case it acts by conduction only; in the latter by evaporation as well, but it is possible this advantage is more apparent than real. It is much more important that time should not be lost, and that the injured limb, especially if it is the ankle, should not be allowed to hang down, as it nearly always is. In some parts of the body, such as the hip, there is no doubt of the superior comfort of the dry method; in others the position in which the limb must be placed, and the facility with which the cold can be applied, form the best guide.

Cold spring water is nearly always at hand. It may be either poured freely over the injured part, or this may be immersed in it. The former plan is the more efficacious; independently of the fact that fresh quantities of water are continually being brought into contact with the skin and abstracting heat from it, and that a certain amount of evaporation can take place as well, it is probable that the actual impact of the falling water, perhaps by the shock and the influence it has on the nerves in making the vessels contract, perhaps by the force of its fall, is of great assistance. As soon as the joint

ceases to swell and the skin is beginning to look dull and livid, the maximum amount of benefit has been produced. It is rarely advisable (at any rate, if pressure can be applied) to carry it any further.

The same effect may be produced by immersion, but unless the water is very cold it is much more slow, probably because the layer next to the skin is soon warmed to the temperature of the body. If ice can be obtained at once in sufficient quantity, the result is as rapid, but there is the disadvantage that it is nearly always necessary to allow the limb to hang down, a position which should always be avoided, as it tends to increase the amount of blood in the part, and sometimes makes it much more painful.

Continuous Application.—A few days after the accident, if by any mischance inflammation does set in, cold may be applied continuously, but then the reason is not the same. In these circumstances it may be kept up for an indefinite length of time. The object is to diminish the amount of blood circulating through the part, and so to lower the temperature and reduce the inflammation. But in sprains, ordinarily speaking, there is not any inflammation to reduce. As Hood and many others have pointed out, there is absolutely no reason why, when a sprain occurs in a healthy person, and is treated with a reasonable amount of care, this complication should set in more often than it does in the case of simple fracture.

The most convenient fashion for its continuous application is by a set of Leiter's coils. They may readily be improvised out of India-rubber tubing (the best is that which has an internal diameter of about one-third of an inch and moderately thin walls), or better still from composition gas-piping, which has the advantage of retaining the shape to which it is bent. They may be applied to any part of the body, coiled round a limb, for example, without the circles being in any way fastened together, or wound in a flat spiral and rested on the part, as in the groin, or pressed into the shape of a low cone and arranged to fit the shoulder. All that is necessary is that there should be two buckets, one containing water of the desired temperature placed on a stool a little higher than the limb, and connected with one end of the coil by means of a piece of tubing; the other, on a lower level, empty, and connected with the other end. As soon as the current is started from one to the

other the flow is continuous, and may be regulated with the greatest accuracy. It is not essential that the cold should be confined strictly to the part actually inflamed. If an ice-bag is laid on a limb over the course of one of the main arteries it causes a very sensible diminution in the temperature of the part below by the constriction it induces, and by the proportionate diminution in the amount of blood.

There are other methods as efficacious, but less convenient. One depends on the well-known fact that if a skein of wool is allowed to hang over the edge of a vessel, so that one end dips in the fluid inside and the other hangs over the edge, a continuous stream of drops will come from the dependent half until all the fluid is gone. A drip pot of this kind, or more than one, suspended over a limb and filled with evaporating lotion reduces the temperature quite far enough. Iced water, or a lotion containing chloride of ammonium in solution, answers very well, but if the full effect is desired there is nothing to equal lead lotion mixed with spirit, and containing a few fragments of ice. The effect is greater in proportion to the amount and strength of the spirit. It may be allowed to drip on to the skin directly, or this may be covered with a single thickness of lint, so as to avoid splashing, and to carry off the surplus fluid. If the lint is folded even once, so that there are two layers, evaporation is checked to a considerable extent, and a great deal of the effect lost.

Arnica, which is frequently recommended in the early stages of sprains, is worse than useless. The sole merit that it possesses is due to the spirit that is mixed with it, and it has the very serious defect of exciting in many people (especially when it is not very much diluted) a peculiar form of inflammation of the skin, which is not only very difficult to distinguish from erysipelas, but which is very likely to run on into it. Aconite, too, may be mentioned here as occasionally of service when one or two small spots are exceedingly tender, but care must be taken, especially when it is mixed with chloroform, that it is not applied over too large a surface.

A still more simple way of applying cold is to fill an India-rubber bag (or where this is not handy an ordinary bladder answers all the purpose) with small fragments of ice, or with ice and salt, and to allow it to hang over the joint so as just to be in contact with it. A double fold of lint, or a thin

pocket-handkerchief, must be placed underneath, lying on the skin and changed occasionally, as it soon becomes wet from the condensation of moist air on the outside of the bag. This plan is particularly useful when it is desirable to produce an effect on deep-lying structures, or to keep the cold up for a considerable length of time, as it is very effectual, may be graduated exactly, does not want watching, and makes no mess.

Cold is most successful in sprains of large joints when the swelling comes on rapidly. If twelve or more hours pass by before this makes its appearance, pressure applied early answers a great deal better, though even then, if a joint such as the knee or ankle has been bandaged carefully, an ice-bag laid on it makes its influence felt, and helps to relieve the feeling of tension and throbbing. When the brunt of the injury is borne by the muscles it is not nearly so serviceable. In the aged, in the very young, in those subject to local congestions such as chilblains, and in the rheumatic, it must be used with great caution, and the skin, if it is moistened, must be dried with the greatest care; otherwise it may happen that the depression due to the cold insensibly shades off into an attack of inflammation, the very thing it is intended to prevent.

Heat.—Heat may be employed in many cases in which the use of cold does not seem advisable. Its value as an immediate application depends on the fact, which is not so widely known as it might be, that hot water, if the temperature is sufficiently high, is as effectual in stopping bleeding as ice. The skin becomes cold, the vessels in it and in the layer immediately beneath contract, and the circulation in many instances almost stops. In the case of the fingers, where in proportion to their thickness the extent of surface is very great, I have seen complete blanching and numbness produced by dipping the hand into very hot water, and have known it last even in the hot days of summer for many hours, longer than if it had been due to the application of ice.

To produce such an effect as this the temperature of the water must be as hot as can be borne. It cannot, therefore, be kept up for more than a few moments, for fear the skin may be injured; and for the same reason it cannot be employed, as cold is, to diminish the calibre of the vessels in the deeper lying structures. Its value is greatest when the in-

jured part lies near the surface, particularly in the case of tendons, which, like those on the back of the hand, run a long distance down into the fingers, lying immediately under the skin the whole way. In the ankle and elbow, also, it succeeds fairly well, but the difficulty of application in the case of other joints is so great that it is generally better to rely on cold.

The temperature of the water requires a good deal of judgment, especially as different people, even different parts of the body, vary very much in their degree of tolerance. With children, it is particularly necessary to be careful, as their skin is so delicate. Happily in them joint sprains are not so common as they are in adults. The fingers can stand a higher temperature than the hand, and this, again, a much higher one than the elbow; indeed, the point of the elbow is, so far as heat is concerned, one of the most sensitive parts of the body. The extent of surface immersed has to be considered, too. It must not be forgotten that the sensitiveness to heat increases with the area exposed. It is not a bad plan to place the limb in hot water, and then raise the temperature rapidly by adding more, until it is as high as the patient can stand, taking care to stir it round all the while, so as to distribute the heat evenly through the whole. Two or three minutes ought to be sufficient; often the full effect is gained at the end of the first.

Heat used in this way has a wonderful power of relieving pain. The skin may not be blanched, but its sensitiveness is lowered; manipulation is more easy, and displaced tendons or other structures can be restored to their position without the sickening sense of over-stretched fibrous tissue. It is worth noting, moreover, as another point in its favor, that the effects are more lasting than those of cold, and consequently time is gained for the application of other and more permanent measures, such as massage and bandaging.

Sometimes, after prolonged overwork or severe strains, the bony prominences to which the muscles are attached become sore and tender, or the tendon sheaths seem to be roughened and uneven, so that perfect smoothness of motion is lost; or in certain classes of work, where without the actual exertion being great, rapidity and delicacy of movement are carried to a very high pitch, the nerves become painful, and the muscles liable to sudden and spasmodic contractions. When this oc-

curs the prolonged application of warmth may generally be relied upon to give relief, at any rate for a time. A moderate temperature usually suffices. The object is not to numb the sensibility of the part, but rather to relax the walls of the vessels and relieve the tension, so that blood may circulate more freely through the tissues, and the delicate fibres, in which the nerves end, may no longer be kept upon the stretch. This holds good even when some of the muscular fibres have been torn across or rent from their attachments.

Later, when the joint is beginning to recover and movement is returning, heat is of value both for its own merits and as a preliminary to massage. There is then no limit to the length of time it may be applied. The hand, for example, if it is stiff from the effects of some old sprain, may be kept soaking for hours in water as hot as can be borne with the greatest benefit. The tissues become soft, everything is supple and flexible, the constant aching disappears, and movements which before were out of the question are executed with ease and freedom; only, unfortunately, it rarely happens that the whole of the improvement is retained. So far as stiffened joints, at least, are concerned, it does not seem improbable that the reputation enjoyed by many of the foreign baths is due more to the temperature of the water and the length of time the limbs are allowed to steep in it than to anything else, though it is not denied that in other respects they may be of considerable service.

Besides these there are other methods, less general in their application, which are better described in the treatment of special sprains. Ironing, for example, is often of great use where large masses of muscle in the loins are stiff and painful from overwork or cold, so that the patient cannot move with freedom or even hold himself erect; and hot vapor or mud baths, where the limbs are stiff and crippled from old attacks of inflammation, frequently procure great relief from pain; but remedies of this description must be dealt with by themselves. As a rule, they are used in conjunction with others, and do not depend for their merit on heat alone.

Heat and Cold Alternately.—Later still, when the repair of the tissues is perfect, but full use is not restored, nothing can be more successful than the alternate action of heat and cold. Some weeks, perhaps, have passed since the joint was

hurt; all fear of inflammation has been dispelled; there is nothing out of place; no bands or adhesions to hurt the movement; no very tender spot, though the whole may ache, especially after it has been used; but there is no power in it. The joint is colder than its fellow; the skin is livid and wrinkled, fitting closely on to the bones, and often slightly swollen where it stretches over the hollows between them; the position of the parts is natural and good; one bone can be moved upon the other, though, perhaps, not quite to its full extent; but the part looks and feels as if it were only half alive, able to put out half the energy it should. Sometimes, it is true, this is the result of defective energy and will in the great nerve centres, but often the fault lies in the part itself. The tissues round the joint have been at rest so long, have been so long without doing anything for themselves, that they have almost lost the power. The circulation through them has been at its lowest ebb for such a length of time, that when a sudden demand is made upon it it is unable to respond. In these circumstances the shock of alternate heat and cold acts as a most powerful stimulus, especially when used in the form of a douche, projected with some force and suddenness against a part which has been allowed to soak in hot water. The skin, of course, receives the greatest amount of effect, and sometimes, especially with the needle douche, a great deal more has been done than was desirable; but the whole circulation through the part is quickened; the volume of blood increases; the nutrition of the tissues is carried on more as it is in normal health, and the muscles and nerves begin at once to regain their power. Aided by galvanism and other measures, it is surprising how this method of treatment restores tone to the muscles, and causes the absorption of chronic exudations that perhaps have remained passive and unaltered for years; only, partly from the very ease with which it may be applied, it is not advisable that this line of treatment should be carried out without suitable supervision; or more harm than good may easily be done.

Pressure.—This is not the only plan which illustrates the value of a time-honored practice, when carried out thoroughly, and its worthlessness as usually employed. Bandaging for sprains is almost universal, and well deserves its reputation; only it must be carried out systematically and rationally, with

a proper regard to the structure of the joint, the arrangement of the parts round it, and the movements it ought to perform; and this implies anatomical and surgical knowledge of no mean order.

Heat and cold are only of temporary use; their influence on the vessels is exerted through the nerves and muscles, and after a time these, like other vital structures, become tired out, relax, and give way. Both of them when continued too long help to produce the very effect they are intended to prevent. The tissues become congested; the circulation is checked, though the actual amount of blood in the part may even be greater than normal; the cavity of the joint is distended; and the soft tissues round and between the bony prominences are filled with exudation, which becomes organized, develops into tough and unyielding fibrous bands, and cripples the movement of the joint in all directions.

As compared with these the action of pressure is entirely mechanical; the measure may be graduated according to the needs of each case, and it may be kept up at any required degree for an indefinite period of time. When carefully and methodically applied, nothing can be more efficient for stopping bleeding, or for insuring the absorption and dispersal of blood that has escaped already. It controls the hyperæmia and checks the dilatation of the vessels, so that the outpouring of the plasma into the tissues is restrained within proper limits. It prevents the accumulation of fluid in the synovial cavities; assists the absorption of plasma from protected spots, so that it neither runs on to inflammatory exudation on the one hand, nor becomes organized and leads to stiffening of the joint on the other; and above all it relieves pain in the most wonderful way, whether it is the sharp and acute kind that comes on immediately after an accident, due to the stretching and tearing of the nerves in the ligaments and fibrous structures, or the dull aching afterward caused by the continued tension on the capsule. In the majority of instances, if compression is properly applied, the swelling disappears by the next day, and the joint may be moved through nearly its whole range without more than a sense of discomfort.

Method.—To bring about this result, however, the compression must be applied with a definite knowledge of what is desired, and how it is to be obtained. Merely putting a band-

age on a limb that has been sprained is only liable to perpetuate the very evil it is intended to prevent.

It may be commenced at once, as soon after the accident as practicable, or heat or cold, as the case may indicate, may be applied for a short time first. Probably in most cases the latter plan is the better; heat or cold requires less skill, and relief from pain is attained more immediately, while, if carried out effectually, time is not really lost. Besides, before a bandage can be applied, it is necessary to make perfectly certain that there is no displacement of any kind. If there is anything of the sort it must be made out and rectified before further steps are taken; it is hopeless trying to cure a sprained joint if any of the structures belonging to it are out of their natural position. How far it may be advisable in these circumstances to make use of massage as a preliminary, is a question that is best dealt with by itself.

The method of application is all important, though the rules that guide it are sufficiently simple. The joint must be fixed in the most suitable position, not necessarily the one selected by the patient. For example, in sprains of the ankle the foot should be at right angles with the leg; when the knee is injured the joint should be slightly bent, though not nearly to the degree in which the patient is almost sure to place it, and the arm should hang by the side when the shoulder is involved.

The pressure must be applied so that it falls only on the parts that require it, not on the bony prominences, that is to say, but over the tendon sheaths, and on the masses of soft and delicate tissue that fill up the interspace between them and the bones, especially on the inner side of the limb. It must be smooth, even, and well graduated, commencing from below, and working upward toward the trunk, and it must possess a certain amount of elasticity, so that as the swelling diminishes under its influence the bandage may still keep up some degree of compression.

For this purpose there is nothing more suitable, and, fortunately, nothing more easily obtained, than ordinary cotton wool. Pads may be made of this to fit into any depression, no matter how small, and, if not too firmly compressed, they keep up an even and equable amount of pressure, even when absorption underneath has effected a considerable difference in the size of the limb. Failing this, the next most useful sub-

stance is a firm and fine-textured sponge. This may be made into pads which admit of the most perfect adjustment as regards size, shape, and thickness, and it is more easy to keep them in their proper place when the limb is being bandaged. Many other substances, however, serve on special occasions; dried moss, for instance, forms a capital substitute, and I have known even seaweed tried with success. Some of the thicker and softer kinds of felt make admirable pads, firm and soft, yet quite elastic, and capable, if several layers are sewn together, of being modeled into any shape. Sometimes this firmness is of especial service. I have employed them with great advantage in sprains of the extensor tendons on the back of the wrist, when the distention has not been very great, but where there has been a large amount of creaking or grating on movement. It is difficult here to adjust pads of cotton wool sufficiently accurately, while the felt is easily shaped to suit the varying thickness of the soft parts. The pressure is distributed evenly over the whole length; the tendons are kept at rest; and the firm compression insures the rapid disappearance of the exudation.

Pads of sponge or felt may, moreover, be soaked in lotions, if it is considered advisable, without altogether destroying their elasticity. I have not found much occasion to put this into practice, but once or twice, when the pain over small joints was very severe, the application of a lotion containing a solution of morphia afforded great relief. Of course, a certain amount of caution must be used. A thick felt pad, covered on the outer side with a layer of some waterproof material, is capable of taking up no inconsiderable quantity, but the area of the pad is generally small, and the condition of the parts beneath is not one adapted for rapid absorption. If there is the least abrasion this caution is particularly required.

It is impossible to be too careful in molding the pads to the proper shape of the limb. In the case of the ankle, for example, where the joint alone is involved, the swelling shows itself on the front, lifting up the tendons that run down to the toes, and behind on either side of the tendo-Achillis, filling up the natural hollows there, and reaching up the leg higher on the inner side than the outer. Over the malleoli, of course, there is none, and, unless the injury has been so severe as to tear the ligaments, scarcely any is perceptible along their

lower border. This may be complicated by the distention of some or all of the tendon sheaths that run down on either side; and if some few hours have been allowed to pass by, there is, in addition, a great deal of thickening in the loose and delicate tissue that fills up the interstices between the skin and the tendons, and the tendons and the bone. The swelling may reach down far on to the foot, and almost to the knee. All this must be made out; and the natural contour of the limb seen, as it were, through the swelling, before the pads can be shaped and the bandage adjusted.

Sometimes pads of this kind may be made to serve in the place of splints. In the knee, for example, a bandage, as usually applied, is of very little use; nor is it much better if a horseshoe-shaped cushion is adjusted around the knee-cap. But if this is combined with a firm elastic pad of felt in the popliteal space behind (I have known, when nothing else could be obtained at the moment, a small folded pocket-handkerchief answer admirably), the compression is spread over a larger surface of the joint, better resistance is given for the bandage in front, and an admirable splint is applied to the knee joint, keeping it nearly straight, and possessing the great advantage over an ordinary back splint that it is not so absolutely and uncomfortably rigid.

Sometimes it is one's misfortune to meet with a case in which the limb (generally the forearm) seems to have been sprained, as it were, all round, the swelling and pain are so universal. For such as these I have used with success what may be considered a distant imitation of Guérin's treatment of wounds; that, at least, first gave me the idea. The limb is to be well padded first, according to the anatomy of the part, and lightly bandaged; then, commencing from the fingers, between which small cushions are placed, it must be wrapped in sheet after sheet of cotton wool until it is three or four times the natural size; finally, it must be bandaged from below upward as firmly as possible. If the cotton wool is sufficiently thick it is impossible to exert too much pressure. It must be admitted that the application is exceedingly hot; but it certainly relieves pain; and such is the elastic tension of the wool, that the limb, when exposed on the next day, is almost its natural size. The comfort is greatly increased by dusting the limb over first with violet powder.

Bandages used for sprained joints need not be of any special kind so long as they lie evenly and smoothly on the limb and do not stretch. India-rubber ones, or those made of woven elastic, are strongly recommended by some; but, it seems to me, without adequate reason. They keep the limb very hot; the solid ones, at any rate, retain the perspiration so as to be sometimes unpleasant; and it is very difficult to apply them sufficiently firmly without making them too tight and converting them into a species of torture. While the limb is being bandaged the pads may be secured in position by means of common elastic bands passed round the limb, an excellent method suggested by Dacre Fox.

Starch bandages and other fixed appliances, such as gum and chalk, plaster of Paris, or silicate of potash, can only be recommended under special conditions. They are certain to be left on too long, and that is a fatal objection. Bandages, as a rule, should be changed every day. The limb no doubt feels fairly comfortable so long as it is encased and kept motionless. But every day it is growing more and more stiff, and when it is released the least attempt at movement is attended by pain. This is not due to straining or tearing of the union between the ends of the torn ligaments; no strain falls on it. Ligaments may be tense, but they are not stretched unless movement is carried beyond what is natural, which, under proper management, never should happen. It cannot, therefore, be due to this. In reality its persistence and severity are regulated more by the amount and duration of the swelling than by anything else. Of course if ligaments have been torn from bones, or muscles have been strained or lacerated, the skin over them is tender when it is pressed upon or tightly stretched, but the pain that is ordinarily felt when a sprained joint is first used is scarcely noticeable if exudation is prevented and passive motion begun early enough. Neither of these conditions is likely to be carried out properly if the limb is encased in a fixed bandage.

How long the limb should be bandaged is a question that can hardly be answered until the effects produced in joints by prolonged inaction have been taken into consideration.

CHAPTER VIII.

TREATMENT.—REST.

Nothing is so difficult in the treatment of sprains as the question of rest— how long the joint should be kept quiet, and when the patient may use it with safety as he likes. It is the first thing asked, and a definite time is usually wanted at once, utterly regardless of the fact that it is impossible to return more than a general answer in the majority of instances. Each case must be judged on its own merits. On the one hand, if the joint remains long unused, there is the possibility, almost the certainty, of its becoming stiff and crippled, so that it is years before it regains its natural freedom, if it ever does; on the other, there is the dread of exciting inflammation, and the risk of reproducing by some momentary slip the whole of the original mischief. Between these it is necessary to hold a middle course; leaning too much to either side inevitably brings after it delayed convalescence in some form or other and much discredit.

There is no doubt that in the majority of cases sprained joints are kept at rest much too long. It is imagined that if anything, it does not matter what, has happened to a joint, it cannot be wrong to rest it, and that no harm can possibly follow from its being kept quiet. The dread of inflammation is allowed to overshadow everything else. It is forgotten that the function of a joint is movement; that this is the reason for its existence, and that if from any cause it is kept absolutely at rest it loses the power of working, just as an eye accustomed to long-continued darkness becomes unable to bear the light. It is forgotten that prolonged rest does produce changes, and very definite ones, too, in the structure of joints, even when they are healthy, and that these are tenfold more likely to occur after injury. And so the part is kept perfectly quiet until it becomes stiff and rigid, and every attempt at movement causes pain.

Effects of Prolonged Rest on Healthy Joints.—Some of the effects stated to result from this cause are of a very striking character. Duverney and Petit have described cases in which they found the synovial sac and the spaces round it enormously distended with a serous effusion; and others in which there were adhesions passing across the interior from one bone to the other, so that the joint was almost crippled. Teissier has given an account of one in which the adhesions were so dense and numerous that the cavity of the joint was entirely obliterated, and the bones so tied together that one could not move in the least upon the other. In others he found the synovial sac distended with blood, the lining membrane thickened, and more vascular than natural, and the inner surface coated over with a recent deposit of fibrinous material, which was rapidly being organized into dense unyielding bands. In many the cartilages were swollen and thickened at the margin, softened in the centre, and even eroded on the surface, while the synovial fringes were almost uniformly converted into tough fibrous bands that limited the fredom of the joint in all directions.

Some doubt, it is true, has been thrown upon his explanation, owing to the fact that in all the cases the limb had been severely hurt; and the suggestion has been offered that these changes are really due to inflammation, which spread from the seat of injury to the affected joint; but it is admitted that there is no evidence that anything of the kind had occurred. According to Teissier, unbroken rest can be the only cause; and in this he is strongly supported by Bonnet of Lyons, who came to the same conclusion after a series of experiments expressly bearing on this point. It is admitted that the position in which the limb is retained is of some importance; that some joints are more liable to be affected in this way than others, those farther from the trunk more frequently than the nearer ones, the fingers, for example, more often than the wrist; and, further, that the changes are most conspicuous in the aged, or in limbs that have been paralyzed; but the main fact itself, according to them, admits of no dispute.

Even supposing the consequences of long inaction are not so extensive as this, they may still be sufficiently serious to lead to grave discomfort and suffering. It is certain that, in old people at any rate, a rest of comparatively short duration is enough to cause great stiffness, especially when the wrist

and fingers are concerned. These show the effect more rapidly than other joints, possibly because the movements they execute are so numerous and complicated; even in a few days the power of bending them may be completely lost; they remain rigidly extended, and the least attempt at forcing them, no matter how gently it is done, gives rise to severe pain, and meets with a sense of resistance which is not due to muscular contraction.

It is often said when this occurs that the patients are gouty or rheumatic, and that the stiffness is due to their diathesis; but there is no evidence of it. It comes on without aching or pain, that is not felt until after manipulation; the skin is not hot; there is no swelling or sign of inflammation; the onset is imperceptible; and the patient is unaware of anything being wrong until the hand is released from confinement and some attempt made to move it. There does not seem any other reason possible but the want of use and the prolonged rest in the straight position.

Changes in the Tissues Due to Prolonged Rest.—When the time is short these are not very conspicuous. There is less fluid in the joint, and its quality sometimes appears to be altered; it is not so viscid as it ought to be; but it is rare to find anything more. The tissues themselves do not seem to be affected as they are at a later period, and recovery is generally rapid. Afterwards there are other alterations; the loose and delicate connective tissue that fills up all the irregularities and interspaces becomes affected. In some parts it is compressed until it becomes dense and hard; in others it is filled with fluid, and becomes soft and pulpy. Then, as the bones and muscles move, and the pressure shifts from one point to another, the uneven tension causes pain. Instead of the tissues yielding smoothly and evenly, accommodating themselves to each other so that no unfair pressure falls on any part, some are hard and resistant, having completely lost their flexibility; others are swollen and distended, so that they cannot give way. The effect, if force is used, is much the same as when a ligament or any other band of connective tissue is stretched beyond its natural limit; the part swells up and becomes painful; the temperature rises; and if the attempt is repeated sufficiently often, the changes become more and more marked until they insensibly pass into inflammation.

In some of the older cases the results are even more serious. The capsule shrinks, and becomes rigid; or, owing to the relaxation of the muscles, loses its tone, and is unduly stretched; the secretion of the synovial membrane is completely altered; the softened parts in the tissues, where there has been no pressure, become, as it were, accustomed to the increase in the size of the space in which they lie, and fill it up entirely; those, on the other hand, that have been compressed, waste away, so that when the two surfaces of the joint are moved apart there is nothing to fill up the interval, unless the surrounding tissues are crushed in by outside pressure. The cartilages grow thinner and thinner; the ligaments shorten, and hold the bones in rigid apposition; the muscles degenerate, and, accommodating themselves to the fixed length at which they are kept, either contract and become converted into a kind of fibroid tissue, or waste and stretch. The tendons, too, at length become glued to their sheaths, and refuse to move; the skin loses its elasticity and suppleness; there is a blue congested look about it; it does not move freely or easily over the structures beneath, but seems shrunken on to the bones, as if it were too tight, and all the soft tissue underneath had gone. Even the bones waste, and become so thinned that a comparatively slight degree of violence may cause them to give way.

In the Fingers and Ankle.—This may happen when the joints are perfectly healthy in all other respects. The fingers have been already mentioned. There is scarcely a fracture of the arm or forearm in which a certain amount of stiffness is not left afterwards. It is not that they have been hurt in any way; they have merely been kept confined in a straight position, under pressure, without being allowed to move, and when released they are found to be stiff and rigid. The same thing occurs in the ankle joint when a patient is confined to bed during the course of a prolonged or exhausting illness. The foot is kept constantly pressed down by the weight of the bedclothes into the same straight line as the leg, and at last becomes fixed in that position; the muscles on the back of the leg become rigid and shortened; the ligaments on the front of the joint are elongated and stretched; and when the patient begins to get about he finds that he is unable to place the sole of the foot flat upon the ground, and, not unfrequently, is com-

peled to undergo a long and tedious course of treatment before the displacement can be rectified.

Not the Result of Injury or Inflammation.—It is quite true that this condition is more common after injuries than anything else; but it must be recollected that they are by far the most frequent cause of confinement in one position. It certainly may occur independently of them, as well as of inflammation; and it cannot be considered a peculiarity of old age, for though it is more often met with in people who have passed middle life, slight degrees of it, sufficiently severe to cause considerable inconvenience, though they yield more readily to treatment, may be found in all periods.

Faulty Position.—Malgaigne has offered the suggestion that stiffening of joints from rest alone is due not so much to confinement in one position (for then it would be more common even than it is in cases of fracture), but to the fact that the position is unsuitable, and, therefore, hurtful. In his opinion, unbroken rest, combined with extension in the straight line, is the immediate cause. The natural position of repose, in which the ligaments are relaxed, lies between the extremes of flexion and extension; if a joint is kept for any length of time rigidly straight some of the ligaments are loose, others are in a state of constant tension. The former gradually shorten, and become rigid and unyielding; the latter stretch, and grow weaker and weaker, or even at last become inflamed, owing to the unnatural condition in which they are maintained. In either case, the suppleness and flexibility are lost, and when an attempt is made to move the joint, pain is caused owing to the fact that the tension falls unfairly on them.

It is not unlikely that this is correct in the main, and that if a joint is perfectly healthy there is not much fear of its becoming stiff, unless the limb is kept in such a position that unfair traction is maintained continuously on ligaments which are not suited to resist it. The important fact is that it may occur—indeed, that in some circumstances it will occur—even when a joint is absolutely sound. If it has been sprained, if the ligaments and the capsule are softened by exudation, and by the changes in the circulation that of necessity take place after injuries, continued rest is almost certain to produce it in a very severe form. The length of time need not be great; very few days are sufficient; and the actual alteration in

structure need not be of great extent; a fold of the capsule may be thickened, or some of the synovial fringes matted together, or there may be merely some induration in the soft tissues, or filling up of the bursal spaces on the outside of the joint, a state of things that may be produced in a few days at the most; it is quite enough to prevent the free action of the joint and to give rise to severe pain if the attempt is carried too far.

In the majority of instances joints that continue stiff and crippled for such a length of time after being sprained show nothing more than this, and it does not appear to be much. There is no heat or redness of skin; the swelling is only such as would be accounted for by the extravasation of blood at the time, and the amount of exudation that is needed for repair afterward; there is none of that throbbing, burning pain which can rarely be mistaken; and there is no sign of inflammation. The reason that makes it so serious is, that when once this condition is set up, unless proper steps are taken to prevent it, there is a constant tendency for it to grow worse and worse. The adhesions and contractions that develop during prolonged immobility cause the softer and more delicate structures to be strained and bruised whenever an attempt at movement is made. Probably, if they are forced to give way once for all, the good that is done far exceeds the harm; but this rarely happens. Much more often either the sufferer does not move the joint at all, so that it is kept rigid longer still, or, if he has sufficient fortitude to persevere, makes matters worse by half measures. The shortened structures are merely stretched and strained, the part becomes swollen again, a fresh amount of exudation is thrown out, the adhesions grow thicker and stronger, and the joint is doomed to a further course of rest under the impression that it is inflamed.

Movement and Inflammation.—On the other hand it is urged, even by those who admit that inflammation is not an absolutely necessary consequence, that it is almost certain to be produced if the part is moved too freely or is used too soon. They agree that, unless there are other causes at work, sprains are not more likely to set up an attack of inflammation than simple fracture or any other form of subcutaneous injury; but they insist that it is absolutely necessary to keep the part at rest for fear of its setting in. It seems to me, however, that in

laying down a rule of this kind it is advisable to be more precise with regard to the extent and character of the movements executed, and the object with which they are performed. The danger of inflammation does not arise from slowly and carefully moving an injured joint once or twice a day; the liability to its occurrence is not increased in the least by this. An attack may be brought on by some peculiarity of constitution, such as gout or rheumatism, or by some morbid condition of the blood, inherited or accidental; or it may be caused by tension if blood or any other fluid is allowed to collect unchecked in the synovial spaces or the tissues round; but it is scarcely possible to imagine that, once or twice in the course of a day, slowly and firmly straightening out a joint that has been sprained could produce any such result.

It is not intended for a moment that anyone should be allowed to do what he pleases with his limb. There is a popular idea that injuries of this kind can be walked off, that only provided the joint is not allowed to rest for some considerable time no ill result will follow; and there are always to be found people ready to declare that they themselves have done it time after time without hurt of any kind, and that they have recovered more quickly in consequence. Sprains that admit of being cured in this way can clearly be only of the very slightest description; for such as these it may answer well enough, but it would scarcely be advisable to try it where the tissues have been seriously injured, or where the swelling and extravasation are of any extent. It is impossible to imagine that the repair of a ligament that has been torn in two or wrenched from its point of attachment to the bone can be assisted by such a proceeding. It may be of service where the strain has fallen on the muscles only and has not been sufficiently severe to tear any of their fibres, or where the effusion is limited to some of the muscular interspaces outside the joint; in others it is a method of cure which is only too likely to end in disaster.

Passive Movement.—It by no means follows, however, that the extreme opposite course should be adopted and the limb maintained in a state of absolute immobility. It is quite possible to move a sprained joint sufficiently to prevent the occurrence of stiffness or the formation of adhesions without causing the least pain or suspicion of inflammation. The first thing is to check the swelling of the part; if this can be pre-

vented passive movement may be carried out with no more than a sense of inconvenience. The pain, throbbing, and risk of inflammation are due to the distention of the joint and tissues round, and to the continued traction exerted on the nerves. If this is stopped at the first the joint may be quietly, but firmly, flexed and extended without causing anything deserving the name of suffering, and without any fear of reproducing the original accident.

Movement undertaken with this object must be passive, not carried out by the patient. Active movements are effected by the contraction of the muscles, acting in their ordinary course, and are executed for some purpose, or in opposition to some resisting power; passive ones, on the other hand, are carried out by some other force, as when one person bends and extends the limbs of another who exerts no strength himself; or when the finger joints of one hand are worked by means of the other. The bones are moved one on the other; the tendons play backward and forward in their sheaths; the folds of the synovial membrane and of the capsule are alternately straightened out and compressed; the pressure points in the tissues are shifted as they are in normal action; and, what is especially important for maintaining their vigor, a certain amount of traction is put upon the muscles and nerves; but no work is done. The joints are treated as complicated pieces of machinery, each part of which is moved by some external force, in a direction, and with a range, that can be limited with the greatest nicety. If one of the restraining ligaments is torn or hurt, no stress need fall on it; if the soft tissues on one side are bruised, they need not be pressed upon; and if a muscle has been ruptured, its ends are not more widely separated from each other. Everything can be regulated with the greatest accuracy.

Time for Movement.—The sooner this is begun the better. It is very rare for the tissues on both sides of a joint to suffer to the same extent. Those on one aspect may be torn, those on the other bruised, from the way in which they are crushed together when it is twisted; but the latter recover long before the former, and are capable of carrying out all their ordinary work at a time when a comparatively slight strain would tear the others in two again. As a rule, passive movement may be commenced from the second day with the certainty of pre-

venting adhesions, and without the least fear; it can be regulated much too well to allow any tension to fall on the injured part.

This answers especially well when the ligaments have suffered most. As a rule, these structures cannot stretch; their function is solely to prevent movement being excessive or passing some definite limit. So long as the range of action is kept within its normal bounds no strain falls on them; they are merely straightened out or unfolded, as it were. When a joint is sprained the movement is carried beyond this, and the ligaments, unless they are strong enough to resist the momentum, yield and give way; but even after this has happened, if the part is prevented from swelling, it may be made to execute all ordinary movements without fear of hurt, provided it is handled carefully by one who knows how much may be done.

It need not be said that hap-hazard or careless movements must be absolutely forbidden. The most accurate diagnosis is necessary to make certain what structures have suffered and what have not; and there must be a thorough and exact acquaintance with the action of the joint, so that the right kind and right degree of movement may be selected; but provided this is done there is no reason why the joint should not be worked in this way from the very first. If it is carried out thoroughly adhesions cannot form.

If a tendon has been dislocated, and the sheath of fibrous tissue which maintains it in its groove torn open, or if one of the cartilaginous discs which exist in some joints, such as the knee, has been displaced, the part may be exercised without fear of reproducing the dislocation or of delaying the union of torn fibres. In the ankle, for example, it is not uncommon for the tendons on the outer side to be displaced forward on to the bone. They are, ordinarily speaking, held firmly down by a fibrous sheath thrown over them, and lined with a delicate synovial membrane; sometimes this is torn, and the tendon escapes from its bed. When this has once taken place a single incautious movement on the part of the patient, before the sheath has had time to repair itself, may tear it open again and reproduce the dislocation; and if this happens more than once it is not improbable that repair never will be carried out; that the sheath will remain loose and yielding, allowing the tendons to slip backward and forward with the slightest

twist until the use of the corresponding muscles is practically lost. But if passive motion is employed systematically and carefully by some other person, who knows what the injury is, and how best its ill-effects may be avoided, the joint may be exercised thoroughly, flexed and extended as far as is desirable, and the nutrition of the muscles permanently maintained without the least fear of this untoward complication.

Even in the most severe sprains, when the staining due to the extravasated blood reaches, as it often does, nearly up to the knee-joint, it is advisable to begin on the second, or, at the very latest, on the third day. All that is necessary is that the whole of the swelling should have been dispersed by careful bandaging, or by other means. The foot is then to be released from all constraint, the skin and the subcutaneous tissues thoroughly kneaded, and the joint quietly, but firmly, flexed and extended several times as far as it is ordinarily in walking. This should be repeated every day until recovery is perfect, the limb in the meantime being as carefully and methodically bandaged as it was at first.

At first, no doubt, there is considerable apprehension on the part of the patient, and probably the muscles are unconsciously kept rigid and resisting; but this is easily overcome by kneading and steady, gentle pressure. Gradually, as the fear of being hurt diminishes, the movements become more and more free until all that is wished can be executed without distress. Pain ought scarcely to be felt. Of course, if a ligament has been torn off the bone, and direct pressure is exerted on the spot, it is felt acutely; but these are the places that should be carefully avoided, especially at first. After a little manipulation the tenderness generally diminishes considerably. If the swelling has been thoroughly dispersed, so that there is no tension on any part of the capsule or the tissues round, and if care is taken not to move the joint, so far as to put undue strain on a ligament that has been stretched or torn, the nerves are not dragged upon or compressed, and the movement is practically painless.

The ankle joint, owing to the plan of its construction, is peculiarly well suited to this method of treatment. Sprains are nearly always caused by the foot being suddenly twisted to one side or the other, so that the greatest strain falls on ligaments, which in all ordinary movements, are only moder-

ately tight. The slightest attempt at bending the foot laterally, in the direction of the original twist, causes the most intense pain, and all the muscles round become involuntarily rigid. All ordinary movements, on the other hand, are allowed to take place from the first, without the least resistance, after the natural feeling of apprehension has been overcome.

I have repeatedly seen the most severe cases treated in this way recover so completely in the course of a few days, that, unless there was an exceptional amount of walking to be done, the patient could follow his ordinary occupation without danger and without pain. Of course, if a ligament is torn across, a certain amount of time is required before it can unite, and still more before it can be firm; but the position in which the structures are placed by this plan is unquestionably the most favorable for speedy recovery. The ends lie in close apposition to each other; no external force is allowed to separate them, and, what is much more important, the synovial cavity of the joint is not allowed to remain distended with fluid, keeping the torn surfaces continually apart. If this is carried out fairly and consistently from the commencement, it is impossible for the joint to become stiff. Adhesions between contiguous surfaces are effectually prevented by the passive motion. The free manipulation renders any rigidity or contraction of the capsule impossible. Unless there is some other predisposing influence, inflammation is equally out of the question. There is no tension to excite it, and, if the compression is properly carried out, there can be no dilatation of the blood-vessels to pave the way for it; nor need there be any fear that afterward there will be that peculiar sense of weakness and insecurity which is so common as a consequence of sprains. In by far the majority of instances this is due to distention of the capsule or yielding of the ligaments; or, when this does not occur, to the fact that the muscles, from being so long unused, have become stiff or rigid, and do not respond as actively or as vigorously as they ought.

CHAPTER IX.

FORCIBLE MANIPULATION.

Few modes of treatment have had a more curious history than forcible manipulation as applied to stiff joints. Often, for years together, in the greatest disfavor, owing, it must be admitted, to indiscriminate application, and almost discarded, it has always managed to retain a foothold in some part or other; and every now and then, when its mishaps have been forgotten, has sprung up again into notoriety, under, perhaps, some change of name. Very few minor operations are capable of giving such instantaneous and striking relief. It often happens that, as a result of some simple manipulation, a joint that has been crippled and the seat of pain for weeks and weeks is suddenly and completely released; but, at the same time, it must be remembered that, unless proper care is taken in the selection of cases, very few operations can do more harm, and also that it is not always easy to lay down rules by which the choice is to be guided.

Adhesions must be Divided or Torn.—If a joint is stiff and rigid from shortening in the fibrous tissue round it, there is only one thing to be done, only one plan of treatment that holds out a reasonable prospect of success: the contracted tissue must be either divided or stretched. Nothing else is of any avail. Baths, whether hot, or cold, or douche; galvanism, massage, friction, counter-irritation, blistering, and the numberless other remedies so often employed, are of little or no service. It is true that the circulation and nutrition of the part improve under their use; the muscles recover their tone and firmness; the skin becomes more healthy in appearance, and the general aspect of the joint is altogether different; but if, when the muscles were relaxed, the movements were stiff and constrained, they will continue in this condition, no matter how energetically these methods are carried out. They are

necessary as accessories; in fact, they are almost indispensable as a means for educating the muscles and nerves, so that they can exert their power again as soon as freedom of movement has become possible; but of themselves they can do little or nothing toward getting rid of the stiffness when there is the least degree of change in the fibrous tissue.

This has been learnt by dint of experience of the roughest kind. The strange idea that sprains are nearly always followed by inflammation (though it is admitted that it rarely results from any other form of subcutaneous injury), and the dread of causing a fresh outbreak by rough handling, have, to a great extent, deterred those who felt the responsibility from adopting more active measures. At least, this seems to be the most reasonable explanation of the fact that, at the present day, though means for making an accurate diagnosis are so much better than they were, and though it is so easy to avoid the infliction of pain, so little is accomplished by this method, and so many people are content to get about, as best they can, with joints which, at the most, have only partially recovered. Even then it is not easy to understand why there should be such objection. Supposing for an instant that inflammation were a much more common consequence of sprains than it really is, it is very unlikely that an attack would be caused by moving a stiffened joint within its natural limits, especially when every precaution is being taken to prevent its occurrence. The popular treatment is absolute rest; but though this, as already mentioned, is necessary under certain conditions, it must always be remembered that a joint can never become healthy so long as it remains unused.

Division.—Of the two methods I have mentioned, the first, division, is very rarely required in the case of simple sprains. Sometimes, it is true, the muscles on one side of a limb become so hard and rigid from long disuse that they refuse to yield to any reasonable amount of force, and then something of the kind must be done; but this is not common. It may occur in the ankle, when a patient has been for some time confined to bed, with the weight of the clothes resting on the front of the foot, constantly pressing it into the same straight line with the leg. When this happens, the muscles at the back of the calf grow more and more rigid, until, if proper steps are not taken to prevent it, they become permanently contracted. If an

attempt is made to move the joint against them, it feels as if two bony surfaces were being driven against each other; it does not yield in the least; the foot is hopelessly fixed, and there is no alternative but to divide the tendon.

Structures that require division are rarely situated close to a joint. As a rule, they have little or nothing to do with its synovial lining, or even with the loose fibrous tissue outside the capsule. For the most part they are attached to distant points, and are either thickened portions of the fascia, which have undergone passive contraction, or tendons of muscles shortened from disuse. These have to be divided before any thing further can be done; but though this is not unusual after a joint has been inflamed, it is rare to find such extensive changes after mere sprains. In any case it is necessary to examine the limb thoroughly beforehand while the patient is under an anæsthetic. It very commonly happens that what is apparently absolute rigidity disappears at once when the muscles are relaxed.

When division is required it must be carried out in accordance with the ordinary rules of tenotomy. A preliminary course of kneading is frequently of great benefit; it loosens the subcutaneous tissue, and makes the skin more supple and yielding; but care must be taken to give the part a complete rest for at least two days before. The fewer the number of punctures, and the smaller the size, the better, so long as it is done thoroughly. Very often, after beginning, it is found that, independently of the superficial bands, there are deeper ones beneath, the presence of which could not be ascertained before; whenever it is safe, they must be treated in the same manner. In all cases the punctures must be allowed to heal before the least degree of extension or manipulation is attempted, for fear of tearing the skin, as this is often exceedingly thin over such parts. In general, four or five days are sufficient. Then, if firm pressure is made with the thumb over the point of section, while the part is being manipulated, the newly-formed fibrous tissue between the deeper structures is easily made to yield without fear of injury to the rest. Failure of union, when a tendon or a band of fascia is divided in only one place, is quite exceptional.

Manipulation.—Manipulation is much more useful than division; it can be employed for such a variety of purposes. In

the early stages it prevents the occurrence of stiffness or the formation of adhesions. Later, when the swelling and heat have disappeared, it is no less successful in restoring freedom and ease of movement, and afterward, when all mechanical obstructions have been cleared away by its use, it is one of the most effectual methods known for bringing back the circulation and nutrition of the part, and giving again to the muscles and nerves the energy which has so long been wanting.

When the object is to set free a stiffened joint, it may be applied in one of two ways. The first aims at breaking down all obstacles at once by a few vigorous but well-directed movements; the second merely attempts to stretch the contracted tissues, little by little each day until they cease to act any longer as an obstruction. The principle is quite distinct. Each plan has its own advocates, but it is especially urged against the former that it is a rough and hap-hazard method of proceeding, likely to excite inflammation, and always liable to do more harm than good.

Rapid.—In certain cases no doubt this may occur. There are plenty of instances on record in which limbs, and even lives, have been lost by reckless manipulation. But this is entirely due to the fact that the cases were unsuitable, and that sufficient precautions were not taken.[1] When carried out properly and scientifically, rapid manipulation is not only more efficacious, but is more free from risk than the slow and tedious process of stretching the opposing tissues little by little.

Strange as it may seem at first sight, there is scarcely anything in the proceeding itself that can cause inflammation. Tearing across bands of fibrous tissue is no more likely to produce it than breaking a bone or dividing a tendon. There is little that is different and nothing that is exceptional in the nature of the injury. A certain amount of blood is extrava-

[1] The following instances in which manipulation was either attempted or proposed are mentioned by the author of one of the most recent and complete works on Diseases of the Joints (Howard Marsh) as having occurred under his own observation:—Malignant tumor of the thigh; malignant tumor of the shoulder; disease of the spine; three cases of scrofulous disease of the knee-joint; hæmorrhoids; and a case in which, after the hip-joint had already been excised, it was gravely declared that the bone was out, and must be replaced. The list could easily be extended.

sated; the vessels dilate; more lymph is poured out to repair the damage; but unless there is some grave constitutional affection present in addition, or it is followed up by serious maltreatment, this is no more likely to excite inflammation than a single bruise or subcutaneous laceration in any other part of the body. The capsule of a joint is always extensively torn in dislocations, but they are never followed by inflammation unless some similar cause is present, and it is difficult to understand why it should be so much feared when the injury is so much less.

Slow and Gradual.—Repeated straining, on the other hand, constantly attempting to stretch the contracted tissues, is one of the surest ways of exciting it. It does not matter how carefully it is managed. Each time a stiffened joint is gently worked the fibrous bands that check its movements are stretched, and very likely slightly torn; each time, in short, the tissues are sprained again, so that they become more and more tender and swollen. One of two things then must happen. Either the interval before the next attempt is not long enough for them to recover, the heat and swelling never have time to subside, and the joint becomes inflamed, though it does not regain its freedom, or for fear of such an untoward occurrence manipulation is abandoned for a time, thorough rest enjoined, and all the improvement lost; the bands regain their strength, and the stiffness becomes worse than it was before. One method aims at restoring perfect freedom at once with a single risk; in the other the danger is incurred again and again, each occasion being worse than the one that preceded it, without the chance of recovery being nearly so good

Accidental Bone-setting.—I must not be understood to advocate indiscriminate employment of forcible movement in all cases alike; it is just this which has brought it into such disrepute, and caused such an amount of opposition; only where other things are equal, adhesions in connection with sprained joints are far better broken across, once for all, than repeatedly strained and stretched. There is no difficulty in supplying examples in proof of this. One I have mentioned already while describing the changes that occur in the tissues round a joint after injury, and it is by no means a solitary, or even an unusual, case. A very similar one was narrated to me a short time since by another patient. According to his

own account, he had fallen down, with his arm outstretched, some time before, and (as was very probable) had dislocated his shoulder. It was reduced by a surgeon, but, for fear of reproducing the dislocation, the arm was kept bandaged close to the side for nearly six weeks. At the end of that time he could scarcely move it, and was almost convinced from the stiffness of the joint that the dislocation had never been reduced at all. It got better, however, by slow degrees, until he was able to move his arm in all directions, except upward and outward; the least attempt at this was stopped at once by a sharp stab of pain on the inner and under side of the joint. This continued until one day, about four months after the original accident, falling down again in much the same way, he felt a sudden snap, which hurt him intensely for the moment. Probably this was due to the rupture of a band, or of some contracted portion of the capsular tissue; at any rate, he found to his astonishment that his arm was from that moment practically free. Nothing afterward could turn him from the belief that the same kind of fall had both dislocated and reduced his shoulder joint. It was certainly wonderful that he did not dislocate it a second time.

In the ankle, when it is left stiff and painful after a sprain or fracture, manipulation carried out in this way is always worth trying. The particular kind of case in which it is likely to be successful can often be recognized at once. The skin over it is red and shining, as if it were stretched too tight; the color disappears readily when it is pressed upon, but is very slow in returning; firm pressure often causes it to pit, especially where there is a large amount of subcutaneous tissue; at the same time it feels cold to the touch. There is no displacement or dislocation; the outline of the bones is quite natural, though all the depressions are partly filled up, and the prominences rounded off; and the tendons can, generally speaking, be traced to their grooves. The position, however, is awkward, so that when standing upright the sole cannot rest flat upon the ground; movement is limited, and exceedingly painful at certain spots; and there is constant aching, especially at night or after any exertion. In several cases such as this, by putting the patient under an anæsthetic and working the joint thoroughly, I have succeeded in restoring perfect freedom of movement, sometimes at the first attempt.

It is essential to recollect in dealing with this part that though the original injury may have appeared to be confined to the ankle, the other joints of the foot rarely escape entirely; and that even if they are so fortunate, they have been kept continuously at rest as much as the ankle, and have undergone similar changes. For want of this precaution, I have seen more than one case fail at the first, and only succeed when the manipulation was extended to the others too.

Sprains of the wrist, again, often leave the fingers stiff and rigid for weeks, long after all heat and swelling have disappeared. In a case recently under my care the patient had fallen, about three weeks before, down a flight of steps, bending his right wrist-joint beneath him. According to his own account, he lay for some time (how long he scarcely knew) unconscious; and on coming round found that his arm was intensely painful, and that there was an enormous amount of swelling over the back of the hand and wrist, extending some distance along the forearm. This was reduced by careful bandaging, so that when I saw him it had almost disappeared, though there was evidence in the staining of the skin by the elbow how severe the injury had been. The hand was quite cool and painless so long as it was left alone, but he had not the least power over his fingers; they lay nearly straight, not apparently hurt, slightly swollen it is true, so that the shape of the joints was too rounded and uniform, but with nothing else about them to show that they had been injured. With the aid of the other hand he could almost bend them down into the palm, though it gave him a considerable amount of pain; but as soon as they were released they sprang back again almost mechanically. He was directed to have the part thoroughly kneaded and steamed for a few days; and at the end of the week was placed under an anæsthetic, and every joint in the fingers and wrist systematically worked through its full range. The next day the hand felt very sore, and was slightly more swollen, but this soon disappeared under massage. Movement was slow, and executed with great deliberation, but the range was much wider, and he was encouraged to use it freely. Two days after full power had nearly returned, and he was able to resume his work.

Where Rapid Manipulation is Suitable.—The joints in which this plan of treatment is most successful are those which

are cold, but not much wasted, where the adhesions are still recent, and especially where, from the pain and tenderness being constant at one spot, there is some probability of the contracted tissues being limited in extent. Hinge joints, in which the movements are, comparatively speaking, simple, and take place only in one plane, can be treated much more easily than ball and socket ones, or those in which the variety of movements is more extensive.

An anæsthetic should always be given unless there is some special reason against it. Not only does it render the operation painless, but by insuring that the muscles are relaxed, it enables the maximum result to be obtained with the least degree of violence. In many cases, indeed, it is necessary, in order to make the diagnosis exact; so long as the muscles are contracted, it is often impossible to give an opinion either as to the strength or the extent of the adhesions. The obstruction itself may be of the slightest description, and the limb so rigid as apparently to have lost the joint altogether. No ordinary degree of force may produce the least effect; but as soon as the contraction of the muscles is done away with, the mere weight of the part is sufficient to separate the adherent surfaces, and restore perfect freedom.

Preparation.—When some time has escaped since the accident, and the circulation is feeble, or when the skin and the subcutaneous tissues appear thin and shrunken, it is not advisable to attempt this without a certain degree of preparation. The joint should be well steamed, or douched with water from a jet of moderate diameter, commencing with it fairly warm, and finishing up with cold; or it should be thoroughly kneaded every day, for a week or a fortnight, to loosen the skin and bring back the circulation. No pains should be spared to insure this. Great stress is laid by some on the use of oil, which is to be well rubbed in; and certain kinds are much more highly recommended than others; but in all probability the beneficial effect is entirely due to the friction. A small quantity of oily matter is no doubt absorbed, but it is impossible to imagine that its action under these conditions is mechanical, as this would imply.

The operation itself is not so simple as might be imagined. It is true that occasionally the most extraordinary recoveries are effected by falls or other accidents; but it must always

be remembered that these are only heard of when they are successful; and that, very probably, they are quite the exception. In the majority of cases failure is much more likely, unless a definite and well-ordered scheme is followed out.

Method.—The chance of success is greatest when the obstruction can be accurately localized. No pains should be spared to effect this. The joint must be thoroughly examined in every position it can be made to assume; any spot that is tender must be marked beforehand; the movements that cause an increase in the pain must be noted, both as regards direction and extent, as well as the least irregularity or unevenness as one part glides over another. It is entirely owing to their power of appreciating minutiæ of this description that some persons have acquired such a reputation for the treatment of these cases.

The patient must be placed so that the portion of the limb between the affected joint and the trunk can be fixed securely by an assistant while the lower part can be freely moved by the operator. In the case of the larger joints, one hand should grasp the limb immediately below, so that the thumb may press firmly on any spot that is tender; the other must be sufficiently far off to secure a proper amount of leverage. All rapid movements should, so far as possible, be in the direction of flexion, combining with it abduction, adduction, or rotation, according to the case, so that the tension may be directed to the required spot.

To carry this out effectually two things are needed beyond all others. The one is a sense of touch so delicate that it can appreciate the least resistance or irregularity of movement; the other an accurate knowledge, not merely of the ordinary anatomy of the part, but of the different degrees of tension that fall on the ligaments in every position of the limb.

Each joint requires a different kind of manipulation according to its construction. In the case of the shoulder, for example, the elbow must be bent so that the forearm may be used as a lever, and the arm rotated first to one side then to the other, bringing it across the chest and carrying it round behind the back before any attempt is made to raise it from the side. Bringing it up at once would very likely dislocate the joint. For the knee Hood recommends the foot of the affected limb to be held by the operator between his thighs,

so that when flexion is accomplished by the hand it may serve as a lever for rotation. This, however, can be effected by the hands alone if the muscles have been relaxed by an anæsthetic. The smaller hinge joints can be managed even more easily, flexion being combined with lateral or rotatory movements so far as the shape of the bone will allow.

There should be no jerking. The movements must be vigorous and forcible, but perfectly smooth; and they must be carried out thoroughly, the joint being moved to its full extent in all directions that are natural to it. Each kind of action should be combined successively with the rest, one by one, so that the tension may fall in turn upon all the different parts of the capsule.

Movements which are especially restricted or painful of course require most attention, but the others, though they may not be affected to the same extent, are not to be neglected. It sometimes happens if these are dealt with first that a considerable proportion of the main obstruction is cleared away, as it were, by side attacks, so that when its turn comes it yields more readily than it otherwise would.

Recent slight adhesions give way at once without a sound, though the sensation is generally conveyed to the hand. When they are older the noise may be as loud and clear as when a bone is broken. Probably in many cases this is due not so much to the actual tearing of adhesions as to the sudden separation of two synovial surfaces that fit accurately into each other. The noise that can be produced in this way, especially if a table or other structure is made use of as a sounding board, is well known.

The after treatment of these cases should be in all respects the same as that of a recent sprain, only if passive motion at an early date is advisable to prevent the occurrence of stiffness in the one, it is absolutely necessary in the other. The joint must be worked systematically every day from the first. If the adhesions have been thoroughly broken across, and if swelling is prevented by compression, it is almost painless. In exceptional cases it may be necessary to administer an anæsthetic the first few times.

Manipulation as an Exercise.—This, however, is not the only use for forcible manipulation. Even when all adhesions have been broken down and the action of the joint thoroughly

re-established, voluntary power is often slow in returning. The joint itself may move with perfect freedom, but the muscles, and even the nerves, seem to have lost their power. It is so long since they have done any work that they have become unable to do any. They are wasted and shrunken in size; the circulation in them is defective; possibly their structure, even, has undergone some alteration. Whatever it may be there is no question that, when a case has lasted any time, their strength and vigor become seriously impaired. The joint cannot be considered cured merely because the mechanical obstacles to its action have been removed; something more than this is required. Recovery is not complete until the natural condition is restored, and the joint is able to undertake active work again.

Exercise, of course, is the most effectual remedy for this. When it can be carried out the cure is rapid and certain, but in many cases it seems impossible. Sometimes there appears to be an actual inability to make use of the muscles, as if the power of the will was unable to reach them. Sometimes the sense of insecurity is so great that the patient cannot be persuaded to place sufficient trust in them. Whatever the cause may be, forcible manipulation is of the greatest service in these cases, especially if it is helped by massage and galvanism. The way in which it is used is, of course, very different to that already described, and the object is different; in the one its purpose is to tear across adhesions, in the other to rouse latent muscular activity, but if used systematically, success, though, perhaps, not quite so conspicuous, is equally sure. Elaborate accounts have been written from time to time of what has been called the movement cure, and many varieties of manipulation have been described in connection with it, but, so far, at least, as the treatment of sprains is concerned, it does not seem clear that they possess any great advantage one over the other. The principle in them all alike is to exercise the muscles according to their strength, to stretch them out, and manipulate them without fatigue. In most cases the greatest amount of benefit appears to be obtained by making use of the different plans successively, beginning with that which calls for the least effort on the part of the patient.

Simple extension, gradually straightening out the muscles, one after the other, with some degree of force, until a distinct

sensation of resistance is experienced, is especially useful in the earlier stages, immediately after the adhesions have been broken down. Sometimes the muscles are irritable, and inclined to painful spasmodic contraction; or hard knots form in their substance, possibly due to rupture of a few of the fibres; or a certain degree of soreness and tenderness of skin makes itself felt over them. Whatever may underlie them, these conditions are often relieved by slowly but firmly extending, one after the other, the various groups of muscles that lie round the joint, and applying firm and even pressure.

What are known as resistive movements are of much wider application. In these the patient either carries out a definite course of action against the resistance of the operator, who is able to select any particular group of muscles, and regulate exactly the amount of work, or the latter makes use of his strength to oppose some voluntary action on the part of the patient, compelling him to give way. The former of these methods is by far the most useful of the two. The secret is to keep the opposing force well within the limits of the patient's strength, making use alternately of flexion or extension, or of rotation inward or outward, as the case may be. Exercise of this description certainly possesses wonderful influence on the nutrition and activity of the tissues, not the muscles only; and with a reasonable amount of care it may be kept up for a considerable time each day without overfatigue. The other plan tires out the muscles at once, and is too exhausting to deserve strong recommendation.

In some cases it is possible to substitute for the hand of the operator mechanical contrivances, arrangements of wheels and levers adjusted to resist any individual movement that may be wished, and capable of being graduated exactly by the patient to suit his own strength. The action, however, is not quite the same. The resistance of a spring or an elastic band cannot be graduated like that of human muscles, guided by an experience of what is required; and unless very carefully superintended the progress of cases treated in this fashion is apt to be very uneven and irregular.

CHAPTER X.

MASSAGE.

Massage, again, which is a most valuable remedy in the treatment of sprained joints, has a history as strange as that of forcible manipulation. It has never been altogether forgotten; some people have always practiced it, more or less carefully, and with a varying degree of knowledge and skill; but at certain times, and in certain countries, it seems to have acquired an extraordinary reputation, and then, again, almost capriciously to have been as strongly condemned. Possibly fashion may account for it in certain measure, for this exerts an influence in the use of remedies just as it does over everything else; but something, at least, must be attributed to the indiscriminate and unscientific manner of its application by unskilled persons in all cases alike, whether they could or could not be benefited by it. Like many other things it has been destroyed by its own popularity.

It is certainly not a novelty; in most countries there has been handed down by tradition from unknown ages a custom of treating injuries of joints and muscles by friction or manipulation, and in some places this has been considered a special prerogative of certain families or individuals, who, by dint of long practice and a certain delicacy of touch (perhaps inherited), have attained no inconsiderable degree of skill. The modern plan is simply the scientific outcome of this; the working has been studied more accurately; its action on the tissues better considered; and certain rules laid down for guidance in the selection of cases.

At one time, for example, Beveridge's rubbers were well known in Edinburgh, and the success that attended their treatment (which was carried out very thoroughly and methodically) had a marked influence on the practice of the Continent. Then the process was almost forgotten, or, at any rate, was

rarely employed, except in country districts, where rubbing is often used, in a rough sort of way, without skill of any kind other than that derived from custom. Lately, again, owing in great measure to the exertions of Dacre Fox, in England, and Graham, Norström, Metzger, and others, abroad, it has been placed on a scientific basis, and received once more into favor. Even at the present day, however, there is too great a tendency to consider it a quack remedy, and to hand it over to persons whose chief recommendation is that they act as untiring rubbing machines, without following any definite rules or guidance.

It is often said against it that those who take it up abandon it again as soon as they have had sufficient experience of its results; they find, so it is alleged, that not only does it require a large amount of patience on the part of the sufferer, as well as the operator, but that it is only beneficial to those who would recover as soon without it, and that in some cases it is actually injurious. As a rule, and so far as sprains at any rate are concerned, this arises from the inability to distinguish massage from mere unskilled rubbing. In reality there is nearly as great a difference between them as there is between painting the wall of a house and the work of a skilled artist. The one requires a certain amount of muscular strength and manual dexterity, the other only comes to those who are by nature fitted for it, as a result of teaching and experience. It may or may not be true that it requires two years, as Dr. Murrell states, to learn the process; that depends on the person and on the previous training; certainly many do not acquire the art even in that time.

As a general application massage is very widely used. There are many descriptions copied from travelers' works of its employment in one form or another among most of the races of mankind. It was largely practiced by the ancients; the Turks and Africans at the present day make use of it; even among the Siberians and Laplanders it may be found in a form modified by the exigencies of climate; while the "lomi-lomi" of the Sandwich Islanders is spoken of in terms of enthusiasm by nearly every one who has written of them for its power of relieving the stiffness and soreness of excessive exertion, and procuring rest and sleep. The effect is described as most luxurious; the process is neither kneading, squeezing,

nor rubbing, but now like one, now like the other, each muscle is manipulated in its turn, beginning with the head and working down slowly over the whole body, until in half-an-hour the weariness has quite disappeared and given place to a most refreshing sense of ease and comfort.

Like many other words that have crept into science from popular usage, massage has scarcely yet acquired a precise or definite meaning. It has been used for every kind of manipulation, whether applied to joints alone or to the whole surface of the body, with the hands only, or with the assistance of instruments. All varieties of friction, pressure, kneading, percussion, and even passive motion, have been included in it at one time or another; and the description of the manner in which it is carried out, and the rules by which suitable cases are selected, are proportionately vague and uncertain.

For all practical purposes, so far, at least, as concerns the treatment of injured joints and muscles, the various processes that have been enumerated may be grouped under the three heads of friction, percussion, and kneading. Passive motion differs to such an extent in its object and method of application that it seems unwise to include it.

Friction.—Of these friction is by far the most simple, and the easiest and least fatiguing to carry out; but its power is very limited, and it has scarcely any direct influence, except on the most superficial structures. It consists merely in a succession of strokings with the hand (using as much of the surface as possible, and fitting it into all the inequalities) from the extremities toward the trunk, commencing lightly at first, and gradually increasing in strength as the part becomes accustomed to it. The knuckles even may be used where the tissues are very deep-seated, or unusually firm. The skin soon becomes red and warm; more blood flows through it, the temperature rises, and, after a few days' treatment, a distinct change may be noticed in the nutrition of the part. Instead of being hard and unyielding, tied down, as it were, to the subjacent tissues, the skin becomes soft and supple, the natural appearance returns, the folds become visible again, and the superficial tissues begin to regain their firmness and elasticity.

Besides this, however, friction exerts considerable influence on the nerves distributed to the skin, and indirectly through them on internal organs, especially on other parts of the

nervous system. The medium through which this takes place is not accurately known. It is possibly the result of the increased activity of the circulation, but more probably it is due to the peculiar sympathy existing between different parts of the nervous system, by virtue of which one cannot be stimulated or excited without influencing the rest. However this may be, of the fact itself there can be no doubt; friction, especially along the back, is often of the greatest service in relieving irritability or sleeplessness.

Combined with baths, and applied generally over the surface of the body, it is of excellent service when the limbs are aching and stiff from over-exertion or exposure to cold. It allays the sensitiveness of the skin, leaves behind it a feeling of well-being and comfort, and does away with the sensation of fatigue. In sprains, however, and injuries of like character, its application is more limited. In recent cases, where there is no extensive laceration of ligaments, and where it is thought advisable to begin massage without delay, it may be used as a preliminary to allay the sensibility of the skin, and accustom the patient to firmer kneading. In old chronic cases, too, where the joint has not been moved for some length of time, it is of undoubted use in restoring the natural tone to the skin before more active measures are undertaken. In other circumstances it is rarely employed for injuries of joints, though it is highly recommended as part of general massage for other disorders.

Percussion.—Percussion, too, whether carried out by means of an instrument or with the hand, is of very limited use. Unless applied with such force as to cause actual bruising, it has no direct influence on any structure deeper than the skin and the subcutaneous stratum of muscles. On the former it produces the same general result as friction, though without its soothing influence; on the latter it acts as a local stimulus, causing each time a single contraction of the fibres beneath, varying in extent and vigor according to the condition of the muscles. To produce the full effect, the movement must be rapid and short, the pressure being raised at once. The weight of the blow must be regulated by the depth of the structure. Great stress is laid by some on the number per minute, when percussion is used for the relief of pain or neuralgia; but, so far as the muscles are concerned, this does not

seem material, though it is as well the strokes should not be too rapid.

The effect is most marked when the muscles are in a state of tension, though the actual shortening produced in these circumstances may be less apparent. When, for example, the lumbar region is being percussed, the patient should stoop forward, so that the muscular slips lying along the side of the spinal column may be placed upon the stretch, and receive the full effect of the vibration. Otherwise a considerable amount of the benefit is lost before the muscular substance is affected at all.

Massage.—Massage, in the strict sense of the term, is a great deal more efficacious, especially with older sprains. Its action is not limited to the skin and superficial structures. These undergo immense changes, it is true; they become softer and finer while under manipulation; their strength and elasticity increase, the extreme tenderness diminishes, and the natural appearance and texture return. The surface loses its dry harsh character and becomes warm and moist again; the livid bluish color gives way to a brighter hue, and the deeper layers of fibrous tissue yield and stretch, so that the hide-bound shrunken condition that is often present after long disuse gradually passes off. But the good effect is not by any means limited to, or even most conspicuously shown by this. When properly carried out massage exerts a simultaneous influence on muscles, nerves, and vessels, in fact on all the tissues within its reach.

The circulation is the first thing to feel its power. It has already been explained how, after prolonged rest, the blood, as it were, lies almost stagnant in the tissues, slowly circulating through them, and neither giving them sufficient for their nutrition, nor removing from them the waste products of their action. This is changed at once. The life of the part is quickened. The veins and absorbents are emptied first, and the fluid they contain driven on to the heart, which fills more rapidly, and contracts more vigorously and firmly. Then the pressure falls on the smaller vessels, and the tiny irregular spaces, full of lymph, which extend in all directions through the tissues. These, in their turn, are compressed and mechanically emptied, their contents being driven on into the empty vessels, from which any backward flow is prevented by

the valves. The circulation becomes more rapid; nutrition is carried on with greater energy, and the actual amount of blood in the tissues at any one time so much increased that they become full and soft to the touch and regain the even and rounded contour of active health.

Next to the skin the muscles seem to experience the greatest amount of benefit. Even after a single application they are capable of doing a great deal more work with much less fatigue. It has often been shown that a muscle, exhausted by lifting a heavy weight many times in a minute, scarcely regains any of its power if it is merely allowed to rest a quarter of an hour. It remains stiff and weak, and liable to irregular and spasmodic contractions. If, on the other hand, it is treated by massage for the same length of time, its strength returns, so that it is able to do as much again with even less fatigue than it felt before.

At the same time the sensitiveness to electric stimuli is increased. Murrell has shown that a current, too weak to cause any response when applied to the motor point of one of the muscles of the arm, is able to produce vigorous contraction after a few minutes' massage. The excitability of muscles, and the amount of energy they are capable of putting out, are regulated—other things being equal—by the way in which they are supplied with food, and the rapidity with which the waste products are removed. This, in its turn, is dependent on the circulation. Each muscle and each bundle of muscular fibres is surrounded by a sheath of fascia, to all intents and purposes quite inelastic; under this is collected the fluid plasma which is the immediate source of the nutrition of the tissues. So long as the muscle is at rest this remains unchanged; when it contracts, so that the shape and consistence are altered, or when the muscle itself is thoroughly and systematically kneaded, the fluid is driven onward into the lymphatics and at once renewed from behind. It is for this reason that massage, so far from causing fatigue, is of such service in relieving it.

The good effect does not pass off at once. If the treatment is continued and a proper supply of food maintained there is a lasting increase in the size and condition of the muscles. Instead of being soft and flaccid or stiff and unyielding, with hard and tender nodules in their substance, so that they rather

impede movement than otherwise, they become firm and elastic to the touch, ready to respond at once to any stimulus, and able, when called upon, to put out a much greater amount of energy.

It is hardly fair, however, to attribute the whole of this improvement to the condition of the muscles only. Massage exerts a similar influence on the nervous system, and though the immediate results may not be so striking in their character, the actual changes are none the less important. During the process itself, and often for hours after, the patient experiences a sense of refreshing ease and comfort. Lassitude and pain disappear; the capacity for work returns, and mind and body alike regain their vigor. Probably this results in no small measure from the improvement in the circulation, as the effect at first is quite local; but from the way in which general strength and voluntary power are restored, in what are known as neurasthenic cases, massage must exert a very considerable influence upon the whole of the nervous system.

In Recent Injuries.—The best proof, however, of the power it possesses over absorption and circulation is shown by the ease with which the swelling and tension can be made to disappear from sprained joints. It is true that in recent cases the greatest care is required, and that nothing is so likely to increase the mischief as rough handling of the part; but when it is carried out quietly and gently, by one who has had some experience, it is very difficult to find anything that acts in so perfect a manner. The whole limb, perhaps, is swollen; the joint distended with blood; the skin shining and tense, much too hot to the touch, and exquisitely tender; but all this vanishes almost like magic. The tension disappears as the fluid is carried off; the pain is relieved, the temperature falls, the natural outline begins to be apparent once more, extravasated blood is broken up, the *débris* dispersed, and adhesions between the torn and bruised surfaces effectually prevented. Sometimes even tendons, which have been turned almost out of their grooves by the accumulation of fluid in their sheaths, can in this way be restored to their position without further assistance.

Such results as these cannot, of course, be obtained in every case of recent sprain, and even when the treatment is successful in relieving the pain and getting rid of the swelling, it

must always be remembered that time is needed for the repair of structures that have been torn. I am convinced, however, that, especially when the stress of the injury has fallen on the muscles, and when the laceration is not too great, this plan may be adopted, not only with the greatest safety, but with an infinitely better prospect of speedy recovery than under the old established method of bandaging and rest. Graham, in particular, lays stress on the fact that the sooner the treatment is commenced after the injury, the shorter its duration is likely to be.

In Older Cases.—In older cases, where the effusion is denser and firmer, and where, owing to the long-continued distention, the tissues have lost their tone, and become sodden and œdematous, massage can be used with much greater freedom. The solid part of the effusion is broken up and disintegrated by the pressure, so that it is driven into the absorbents and carried away by the increased force of the stream; the chronic congestion is dispersed, the blood circulates more freely, the tone of the part returns, and the lifeless, helpless look disappears day by day. The improvement is often surprising in its rapidity. A joint that has remained for weeks cold and inactive, the seat of a constant wearing pain, and quite incapable of performing its proper movements, in a very few sittings begins to recover its flexibility, loses the pain, and allows itself to be handled, and passive movements to be carried out with ease and readiness.

Active movement, in general, takes some time longer, for the muscles grow so stiff and rigid from prolonged disuse that they require as much education as the joint itself. The case that furnishes the most striking cure is a sprained joint that has been treated by bandaging in the conventional way, where the œdema still persists, and where there are no adhesions round other than those caused by the rigidity of the capsule and the swelling of the soft tissues. Even if weeks have passed, the effect may be seen after the second or third sitting. Only where, owing to the great length of time, the effusion has become thoroughly organized, and where the structures round are shrunken and matted together by dense, unyielding fibrous tissue, it is of little avail until the joint is set free, and full range of action restored by vigorous passive movement.

Method.—The method of application is not easy to de-

scribe, and it can only be learned through practice, even by those who already possess a fair knowledge of anatomy. This is indispensable; without it, massage must degenerate into mere rubbing. Each group of muscles must be known, where it ends and begins, how thick it is, and how the tendons lie, where the intermuscular septa of connective tissue come, and where the vessels and nerves that supply the part are situated. All the natural movements and the different arrangement of the structures in various positions of the limb must be perfectly familiar. The synovial cavity of the joints and the tendon sheaths must, as it were, be mapped out underneath the skin. In short, there must be a thorough practical knowledge, not only of the anatomy of the part at rest, but of the direction and mutual relations assumed by the different structures when at work.

Supposing the case of a sprained ankle of moderate severity in a healthy person, a few hours after the accident the ligaments are strained, perhaps even slightly torn; the synovial cavity is distended with fluid, the tissues round are swollen out with extravasated blood, the skin is hot and discolored, the normal shape of the joint is lost, and all the hollows between the bones are filled up. The patient must be seated comfortably, so that the muscles are, as far as possible, relaxed; the knee must be bent, and the foot and ankle given over altogether to the manipulator. The foot is to be held gently but firmly, so that the patient may make no incautious start, and the whole proceeding from first to last should be entirely devoid of pain. The operator should have plenty of room, so that he is not cramped; perhaps as convenient a position as any is kneeling on one leg, or sitting on a low seat in front of the patient, with the heel of the injured limb resting on the front of his knee. The movement at first must be exceedingly light, and so directed as to diminish as much as possible the sensitiveness of the skin, commencing with the part above (nearer the trunk) the injured joint, and working gradually downward. The thumb, or the tips of the fingers, or the palm of the hand, should be used according to the shape of the surface, taking care always to employ as much as possible.

The direction of the movement must always be toward the trunk, from the insertion to the origin of the muscles, in the direction of the returning current of the circulation, com-

mencing over a part where the swelling has not yet shown itself, and gradually working on to the rest. The most tender spots must always be left till last. If, for example, the foot has been twisted outward, there is nearly always great sensitiveness over the tip of the internal malleolus, and a considerable amount of swelling along the course of the tendons behind, extending a variable distance up the leg, and into the hollow in front of the tendo-Achillis. This must be left until friction has been applied over the whole of the rest of the foot and leg; if this is carried out thoroughly not only does a great deal of the swelling disappear of itself from the injured part, but owing to the condition of the circulation through that which has been already manipulated, the remainder is absorbed much more readily than it otherwise would be.

Gradually, if the treatment is persevered in, the tendency to start on the part of the patient, and even the involuntary shrinking, disappear; the foot is given up to the operator with greater confidence, and the superficial general swelling begins to diminish. More attention may then be paid to the spaces in which the extravasated blood has collected to the cavity of the joint and the tendon sheaths. The tips of the fingers, or the thumb, may be made to trace out the irregular intervals between the bony prominences moving round and round in small circles on the skin. The two hands should be used close together, so that the paths the fingers traverse intersect each other, and the manipulated surfaces overlap. Gradually, as the effusion subsides, the circles increase in size, the pressure becomes firmer, and the deeper-lying structures are treated in their turn. The individual muscles and tendons are grasped and squeezed in the direction of their fibres, the fingers being always carried onward toward the trunk in the interspaces between them; and the soft tissues are firmly pressed, and, as it were, rolled along by one hand after the other, until all the excess of fluid has returned once more to the blood stream, and slight passive movements of such a nature as not to exert any traction on the injured ligaments are allowed without resistance.

This is to be taken as the sign of success in the treatment of recent cases. How long before it is reached differs naturally in each individual, and no rule can be laid down. Sometimes in slighter injuries a single short sitting suffices; at

others the process must be repeated for several days. The time that has elapsed since the accident, the condition of the joint, the degree of swelling, and the severity of the pain, all possess some degree of influence. As a general rule, if the injury is recent, there is more tenderness about the part, but the swelling disappears sooner; in older cases firmer pressure may be used from the first, as the skin is less sensitive; but the time before the swelling is absorbed, and movement becomes free and painless, as a rule is much longer.

At the close of the sitting the joint and the limb must be bandaged with pads of cotton wool, so arranged as to fill in all the natural depressions of the part. If they are held in place with a flannel, or better a Domett bandage, the joint may be moved a little, though the pressure is sufficient to prevent the return of any great degree of swelling and œdema. But, however carefully the bandage is applied, it nearly always happens that the next day some of the fullness and tenderness of the part returns, so that another sitting is desirable. If the case is going to terminate favorably, each application is shorter and less painful than the last, and each time the range of passive movement is increased.

It must clearly be borne in mind that, though this method of treatment causes the swelling to disappear more rapidly than any other, and allows the return of slight degrees of movement without pain almost from the first, a ligament that has been torn across requires nearly as long for repair as when it is left alone. Consequently, when it comes to the question of dealing with sprains of great severity, such as often are met with in the ankle, all that is done, and, indeed, all that can be done, is to restore the parts to the condition best suited for repair, and to guard, as far as possible, against the after troubles of stiffness, chronic œdema, and pain.

In older sprains, the method of application is somewhat different. Here much less stress is laid upon light friction, and much more upon deep manipulation and rolling of the parts. The object is not so much to cause the absorption of a fluid exudation as to stimulate the muscles and nerves to greater activity, and to increase the amount of blood and lymph circulating through the deeper strata. The grasp is firmer, and the pressure greater; the whole hand is used, and both at the same time; if, for example, the limb is not too large, one may

be placed opposite the other, so that two groups of muscles are manipulated together, the fingers of one hand partly reaching on to the territory of the other. One hand contracts as the other relaxes, each, in its turn, squeezing the tissues onward and away from the middle line, and stretching the parts that lie between them. Care, of course, must be taken not to stretch the tissues in opposite directions at the same time; and it is a wise precaution to go over the surface gently and superficially before attempting deep or thorough manipulation.

Where other joints are concerned, the treatment must be conducted on essentially the same principles, varying the details according to the circumstances of each case. The operator should always keep sufficiently far off so that his movements are not cramped or constrained, and he should always endeavor to make use of as much of the surface of his hand as possible. The fingers must be kept close together for the sake of mutual support; they should not be allowed to slip too much upon the skin, which should move with them as far as possible, or the operation may be a very uncomfortable one for the patient. For this reason ointments and other similar applications are very rarely used unless it is wished either to diminish friction or to produce some specific effect.

The patient must be placed in an easy and comfortable position, with the limb well supported, and, where possible, well raised, so as to assist the return circulation. If, for example, the wrist is the part in question, the point of the elbow should be resting on the table; if it is the elbow itself, or the shoulder, the patient should either rest his hand on the shoulder of the operator, or should even lay hold of something higher still.

The hands must always lie in the direction of the muscular fibres, and the rolling and squeezing always tend upward from the extremities toward the trunk. The rate of movement and the amount of force that is used must vary with each individual; but there should never afterward be any sign of bruising due to the manipulation. It is always present, of course, to a greater or less extent, in recent sprains, and it is nearly certain to be there if adhesions are broken down or a joint is forcibly manipulated under an anæsthetic; but it never occurs after massage unless the force used has been ex-

cessive and unjustifiable, and its presence generally means that more harm than good has been done. Instead of assisting in the repair of the damage it has inflicted more.

It is most essential to commence as gradually and as gently as possible, only working on the deeper tissues after the more superficial ones have become thoroughly accustomed, and have been unloaded of their surplus fluid. The skin, the soft subcutaneous tissue, the muscles, and the deeper layers, must all be worked in turn. Nor should the manipulation be confined to the injured part. In a sprain of any standing the whole of the limb is affected more or less. It is usually better to devote attention first to the parts nearer the trunk, than to deal with those around the injured area, and only afterward, when the circulation is thoroughly re-established, to manipulate the joint itself.

The tendency is to make the sittings last too long. Deep manipulation itself rarely requires more than five minutes; but in dealing with a recent injury it may be advisable to spend a longer time than this over the friction and other preparatory measures, so that a quarter of an hour soon passes by. When the tenderness is very great, and the amount of swelling excessive, much longer than this may be necessary, but short, frequently repeated sittings are of greater benefit than one long one. A skilled operator, too, will often effect more in a few minutes than an ordinary rubber will in as many sittings.

CHAPTER XI.

SPRAINS OF TENDONS.

Sprains of tendons are deserving of as much consideration as those of joints; they are almost as common; the changes in the tissues are nearly as serious, and the results, though they vary a good deal, are in many respects quite as important. Unless perfect freedom of movement is regained, there is an amount of suffering and inconvenience often altogether out of proportion to the extent of the mischief.

Structure.—In one respect the question is much easier; the structures concerned are not nearly so complicated. The shorter tendons are merely unyielding bands of various shape, directly connecting the muscle to one of the adjacent bones. They are formed of tough fibrous tissue, continuous, on the one hand, with the membrane investing the bone, and, on the other, spread out to receive the attachment of the muscular fibres. The longer ones are more or less rounded in shape, and are inclosed in a synovial sheath, practically identical with that which lines the interior of joints. The surface is as smooth as it can be, so that the tendon glides without friction in its groove, no matter how many bends or curves it makes, or how often the position and direction of these vary in different movements of the limb. The interior is lubricated by a fluid identical in character with that in joints, just sufficient in amount to fill up all the interstices, and enable the sheath to fit closely and evenly round the tendon. The outer wall is formed of a fibrous layer, which, though apparently distinct (just as the capsule of a joint appears distinct), is only a layer borrowed, as it were, from the delicate tissue round. Owing to the friction, this is condensed into a firm membrane, smooth and polished on its inner surface, but rough on the outside, where it still retains its connection with the fibrous tissue from which it was formed.

In some parts of the body each tendon has a separate

sheath surrounding it like a tube. At the ends this is continuous with the sides of the tendon, so that the cavity is completely closed. It is largest and best developed where there are projecting points of bone, and where the direction of the pull is consequently altered. In many parts the sheaths of two tendons lying side by side communicate with each other; and where, as in the wrist or ankle, the number of those running in the same direction is considerable, there is only one large sac surrounding them all. Sheaths of this description are much stronger and stouter, the walls are thicker, and owing to the bundles of tendons lying side by side, each moveing independently of the rest, are ribbed, as it were, on the inner surface with longitudinal ridges, which sometimes project as actual folds, inclosing between their layers a mass of soft and delicate tissue well supplied with minute vessels. In the young the lining membrane itself is quite smooth, so far as its inner surface is concerned; but as age advances, particularly in those whose work is laborious, or whose joints and tendons are exposed to heavy or repeated strains, it undergoes great alterations. The folds grow stouter and longer, their free margin becomes irregular and broken up into fringes, and the tissue of which they are composed becomes tougher and firmer, until in some instances the surface is as irregular and as shaggy with villous processes as the interior of a joint affected with chronic synovitis.

Effects of Age.—This, however, is not the only alteration found in tendon sheaths after adult life. There is a slight but constant tendency for them to enlarge and encroach on surrounding structures. Where two lie side by side, or where one is in contact with the capsule of a joint, the dividing wall in course of time grows thinner and thinner until it gives way altogether, so that the cavities communicate with each other. In other instances, where the tissues round are soft and yielding, the sac expands unevenly, and becomes covered over with irregular dilatations. If the wall is especially weak at any one spot, or if from some accident the fibrous layer of the sheath has been torn, the lining membrane is forced out little by little into the interspace, until it assumes the shape of a pouch, opening into the sheath by means of a long and sometimes very narrow neck. When one of these is once formed it generally continues to increase in size. Fluid is driven into it

with very considerable pressure every time the tendon moves without there being any corresponding force to insure its return; the sac grows larger and larger until it projects beneath the skin, or even opens up a communication with some more distant cavity. It is in this way that tendon sheaths become connected with neighboring joints, the pouch developing originally sometimes from the one, sometimes from the other.

In the majority of instances it is difficult to say how far these changes are the result of time alone, and how far they are the product of repeated sprains, and of attacks of rheumatic gout. In joints there is no question that these causes are of material assistance, to say the least. Whenever large diverticula are present, or the interior of the synovial membrane is more than usually irregular, one or other of these has been at work. The same is probably true of tendon sheaths and of bursæ; the alterations are not serious except under these conditions. Slighter degrees, however, tending in the same direction, but not going further than a moderate amount of dilatation and thickening, are so common, and so consistent with what takes place under the same conditions in similar structures, that there is no doubt they are due, in part at least, to the natural degeneration of the tissues occurring everywhere as age advances.

Extent of Injury.—The tendons themselves rarely sustain much injury in the case of sprains. They are formed of little more than tough bundles of fibrous tissue closely woven together, so that if they escape being torn in two, or wrenched from the muscle to which they belong, they generally escape altogether. The sheaths, however, in which they lie make up for them in this respect. They are so delicate in structure that they are torn or bruised by the least unusual strain, and the relation they bear to the tendon they inclose is so accurate that the slightest alteration is sufficient to produce a very considerable effect.

Overwork.—Serious consequences are, of course, much more likely to be produced by violent injuries, but mere overwork is sufficient to affect the synovial lining and to cause inconvenience and actual pain. It need not be excessive; it is enough that it should be more than usual, and that it should be kept up for some time. Instances of this are of every-day

occurrence when an unusual degree of exertion falls on a group of muscles that are not accustomed to it. The movements of the tendons are no longer easy and natural; a hot, burning sensation is felt each time the muscle contracts; there is a feeling of tenderness and fullness over it; the temperature (as taken by a surface thermometer) may even be slightly raised, probably from the larger amount of blood that is flowing through the part; and, what is the most striking and characteristic symptom of all, as the tendon plays backward and forward in its sheath there is communicated to the finger a delicate sense of crepitation and rustling, as when two surfaces of silk are being rubbed together. Sometimes this is perceptible to the patient himself, at others it can only be elicited by carefully applied pressure over the tendon sheath. Whenever it occurs it may be accepted as clear proof that there is some alteration in the relation between the tendon and the membrane round it. Naturally it can be felt most plainly where a number lie close together beneath the skin, as on the front of the ankle joint or the back of the hand. In situations such as these, any unaccustomed degree of exertion, walking, for example, some distance unusually fast, or feathering in rowing at the commencement of the season, or even carrying a heavy weight in the hand, is sufficient to cause it.

Tenosynovitis.—It has been imagined by some that this peculiar sensation is the result of the sheath becoming dry. The synovial fluid is, as it were, used up, and the movement of the tendon over the dry and roughened surface causes friction. It is very difficult to understand how this can occur; such a condition of things would be almost unique; nowhere else does use, even when carried to the greatest excess, entail any similar result. The immediate effect of muscular contraction is to increase very largely the amount of blood flowing through the part, and to cause a much larger quantity of lymph to pour out through the walls of the vessels into the surrounding tissue spaces. It is difficult to understand how, under such conditions, the sac of the synovial membrane could become dry. The walls contain a greater amount of blood, they are softer and thicker, the lining layer of cells is not so perfect, their growth is more rapid, so that they have no time to assume their normal flattened shape, and the character of the fluid in the interior is modified by being mixed with the exuded lymph

and with the cast-off cells; but the quantity is rather increased than diminished.

Lawn Tennis Arm.—The same symptoms (with the exception of the rustling) are produced by over-exertion when the tendon is attached directly to bone without the presence of any investing sheath of synovial membrane. A common instance of this is met with in a variety of what it is the present fashion to call lawn-tennis arm, though a similar thing was described long since in Australian diggers. There is a tender spot about the middle of the forearm, on the outer side of the bone, corresponding to the attachment of one of the muscles that is used especially in back-handed strokes; and sometimes the tenderness is so great that I have known it the source of great uneasiness. The skin appears slightly swollen and raised above the normal level; but it is quite white, even whiter than the surrounding part, and the swelling so soft that it can be appreciated much better by the eye than by the touch. In moderate cases it is limited to this point, and the muscle itself is not affected; only when it contracts there is a feeling of soreness and stiffness, not, perhaps, amounting to actual pain. In severe ones the swelling extends over the whole muscle.

The changes here are essentially the same; owing to the increased wear and tear more blood flows through the part; a larger amount of exudation is poured out into the tissues, through the walls of the vessels; the skin becomes more highly sensitive, so that it feels sore and tender when even light pressure falls on it; and the action of the muscles is difficult and painful. Only there is no crepitation or rustling, because there is no synovial sheath in which the fluid can collect.

Muscular Strains.—Under some circumstances the exertion required to produce such a result may be exceedingly trivial. It is not uncommon for patients who are recovering from an attack of severe illness, when they are allowed to sit up for the first time, to complain, after an hour or two, of soreness over certain bony prominences, and of a sensitiveness of skin that is sometimes mistaken for hysteria. There is a line, for example, at the back of the head, or a space between the shoulder blades, where the least pressure is painful, especially after they have been sitting up some time. In the morning, or after a long rest, nothing of the kind is felt; the muscles can act freely and naturally. It is only when they are tired out

that these symptoms begin to appear. The work that they are called upon to perform is too much for them; they have been weakened to such an extent by prolonged illness and want of exercise that the exertion of sitting upright is as much out of proportion to their strength as severe and prolonged labor would be if they were in good training. There is, it is true, no appreciable amount of swelling, but it is quite sufficient for the purpose that the tender points of bone correspond with very fair accuracy to the attachments of the muscles that receive the strain. Rest at once relieves it, and as the nutrition improves and strength returns the symptoms rapidly disappear.

The same thing is frequently met with in connection with the abdominal muscles after vigorous efforts of any kind, and it is sometimes so marked that I have known it mistaken for more serious disorders, especially as the muscles are often thrown into a state of cramp, so that they do simulate, to some extent, internal tumors. There is the same burning sensation when contraction takes place; the skin feels tender and sore, and its sensitiveness is extreme (as it frequently is in hysteria), the patient wincing at the slightest contact. Sometimes the feeling of soreness is worst over the points where the muscles are attached to the bone; but more often the patient refers it to the junction of the muscular and tendinous fibres; and it is remarkable and very characteristic of this muscular overwork, that nearly always, in indicating the seat of the pain, the patient moves his hand, quite unconsciously, in the direction of the fibres that have had the severest strain.

Injury to the Sheaths of Tendons.—In sprains, however, the trouble is generally more serious, and the symptoms more definite. When, for example, a man falls down with his hand and forearm doubled up beneath him, so that the whole of the stress falls on the tendons at the back of the wrist, and the soft and delicate tissues lying underneath are crushed against the bone, the amount of damage sustained is not to be mistaken. Within a very few minutes the wrist swells up, the tissues are bruised, the vessels torn across, and blood poured out into the tendon sheaths and the structures round, just as it is when any other part of the body is injured. Only because there is a sac in which the fluid can collect, the swelling is unusually rapid in making its appearance, and is limited at

first in shape. Soon, however, it begins to spread; the back of the hand swells up, though here it always feels softer than it does elsewhere; then it extends along the forearm, and even makes its appearance on the front of the wrist, probably because the tissues in this situation were crushed and squeezed at the moment of the fall. The skin becomes hot and tender; movement at the wrist is completely lost; the joint is kept nearly straight, and can neither be bent nor extended; the former movement is too painful, because then the extensor tendons are pressed against the part of their sheath that has already sustained the severest hurt; the latter is almost impossible, as tendons cannot work when their sheath is distended with fluid. Even the fingers suffer in the same way; though a certain amount of flexion is permitted, they cannot be bent into the palm of the hand or completely straightened out.

After a few days the bruise begins to come out near the elbow (generally on the front surface of the joint) and, perhaps, in the hand; the coloring matter from the blood soaks by degrees into all the surrounding structures, and spreads along the looser planes of cellular tissue until it reaches the skin. The swelling slowly diminishes, remaining longest over the tendons; the tenderness becomes more definitely localized, being chiefly felt over that part of the back of the wrist which corresponds to the spot where the tendons were most bent and crushed against the edge of the bone; the movement becomes more free; the amount of grating and creaking grows less and less, and if no adhesions have formed, and there are no other troubles to hinder the progress of recovery, voluntary power slowly comes back, though even in a moderately successful case it is sometimes months before all the thickening has disappeared and the joint can be completely flexed.

Inflammation.—Sometimes it happens that instead of the extravasated blood being absorbed, and the movements returning in this way, inflammation sets in either as the result of some constitutional predisposition, such as gout, or from the excess of tension in the tissues. Ordinarily speaking, it is not present at all. The changes which have been described above are identical with those that accompany any severe bruise; the swelling has been already accounted for; the increased amount of blood flowing through the part, causing the skin to become hot and sometimes red, and making it at the

same time more sensitive to pressure, is only what is required by the increase in the need for repair; the pain is due to the tension caused by the extravasation and effusion; and the loss of mobility is the result in the early stages of the distention of the sheath (for unless the tendon is tightly grasped it loses all its power) and of the pain when the torn and bruised tissues are pressed on; in the later ones, of the imperfect absorption of the lymph that has been thrown out and of the stiffness caused by prolonged rest. These are the great causes of the delayed convalescence and of the obstinate rigidity that so often follow such injuries. In the majority of instances there is no more inflammation after these than there is after a simple fracture or a severe bruise.

When it does break out the severity of the symptoms is not easily mistaken. The pain is intense; it is no longer a question of a hot or burning sensation felt when an attempt is made to move the tendon; the whole extremity throbs from one end to the other. The temperature rises rapidly; the skin grows red, and, if suppuration is going to follow, becomes thick and swollen, so that it pits on pressure and can no longer be raised up from the structures that lie beneath. At the same time there is high fever, with headache and constitutional symptoms of great severity.

Inflammation of this description rarely remains limited to the space in which it begins. Sheaths of tendons and bursæ are, so far as their development is concerned, merely great interspaces in the cellular tissue, and they never lose their connection with the others around them. If they become inflamed, and their contents suppurate, the way lies open for the pus to spread through all the cellular tissue of the limb. It may even extend into the neighboring joints without there being of necessity any direct or open communication between them. I have many times seen complete destruction of an articulation, even of such a one as the knee, occur as a result of deep-seated suppuration that had found its starting-point in the inflammation of a neighboring bursa or tendon sheath.

Imperfect Recovery.—Imperfect recovery, stiffness, and loss of power are much more common. For a week or two everything goes on well; the symptoms gradually diminish in severity; the pain becomes less and less; the swelling disappears, except immediately over the tendons (there it always

lasts the longest), and a certain amount of voluntary movement is regained. But then the improvement stops. Every attempt at further progress is checked at once by pain, and is followed by an increase in the swelling. The muscles begin to waste; the neighboring joints and tendons become stiff from prolonged disuse; and sometimes the improvement already won is lost again, and free movement of the tendons never returns completely.

There is no doubt that this is much more likely to happen if the tendon sheath has been inflamed, and that then the results are, generally speaking, much more serious. Even when it subsides fairly soon, inflammation, if it once involves a tendon sheath, always leaves behind it extensive, and sometimes permanent, changes. But it is also certain that loss of movement, and other troubles, are met with after injuries of tendons in which inflammation never occurs at all. Complete and permanent wasting of the muscles, and an absolute degree of rigidity, may be uncommon; but, independently of these, sprains are liable to be followed by a number of other consequences, which have nothing to do with inflammation, and which are quite sufficient to give rise to the gravest inconvenience, and even to prolonged suffering.

Stiffness, for example, is rarely absent altogether. Some time always passes before the tendons move, as they ought to do, so easily that there is no consciousness of their existence. Pain is equally common, and, indeed, is in general severe in proportion to the stiffness. It differs immensely in different cases. In some there is a constant sense of aching, and of soreness over the whole part, even when it is at rest. In others it is only felt on movement, and then with great severity over certain spots. Swelling nearly always persists for a time. The sheath is distended with fluid, or cysts develop in connection with it; or there is some effusion into the cellular tissue round, sometimes soft and yielding, at others hard and irregular. It may continue without material change for an almost indefinite time; more often it increases slightly in amount as often as the tendon is much used. The skin may remain exceedingly tender, especially over those spots where the swelling is greatest, or where pain is felt when the tendon is moved. Creaking and grating are almost universal. It is not merely the delicate rustling, already mentioned, due to the alteration

in the lining cells, or to blood or lymph being mixed with the synovia, but a much rougher, coarser sound, caused by the presence of fringes, projecting up from the folds of the lining membrane, like those in joints; or else by myriads of loose bodies floating about in the fluid, in which the tendon lies and moves. Louder noises even may be audible in the later stages, caused, in all likelihood, by the sudden separation of two surfaces that accurately fit each other.

Very often there is a peculiar feeling of weakness—not so much actual loss of power in most cases as a sense of insecurity. It occurs even with an ordinary ganglion on the back of the wrist, and is almost invariable when one of these is large enough to project distinctly under the skin. The patient complains of inability to use the hand, the flexor muscles being as much interfered with as the extensor, owing, no doubt, to the way in which they are always trained to act together. When the dilatation involves the sheath itself, the sensation is never wanting. I have seen an instance in which a patient was quite unable to bend his middle finger, merely because the sheath of the flexor tendons along the under surface was distended with fluid. There was no other obstacle; it could be bent by the other hand, as far as mechanical considerations would allow; and as soon as the fluid was removed by subcutaneous puncture, full power was regained.

Even this does not exhaust the list. There are other consequences following sprains of tendons, similar to those already described in the case of joints, involving parts that have not sustained any direct injury. Wasting, rigidity, and loss of power in neighboring muscles; stiffening of the capsules and sheaths of other joints and tendons; filling up of the cavities of bursæ and other periarticular spaces; and many others which are probably the result of prolonged rest and confinement in one position, rather than of anything else. Inflammation, when it does break out, makes them all tenfold worse; but it is not by any means necessary for their occurrence. The injury sustained when a tendon sheath is badly bruised, and then kept perfectly quiet for an indefinite length of time, is quite sufficient to account for them in most cases without calling in the aid of anything else.

Treatment.—So far as general principles are concerned, the treatment of tendons, after they have been sprained, is very

similar to that already described in the case of joints. The great object is to restore the power of voluntary movement as soon as possible; everything else must be subordinate to this. Until this is perfect, recovery cannot be said to be complete.

The first obstacle is the extravasation of blood into the tissues, and the amount of lymph poured out afterward to effect the repair of the injury. The soft and vascular tissues, some of the most delicate in the body, are crushed and torn; blood flows out in all directions, until, if it is not checked in some way, the sheath and the cellular spaces round can contain no more. Then all the vessels dilate; everything swells up and becomes soft; the interstices in all directions are distended with lymph, which gradually takes the place of the blood as this is absorbed; and if no steps are taken to prevent such a result, the tendon, its sheath, the delicate tissues round, and even the neighboring muscles and fasciæ, so far as the injury has extended, become glued together. Of course, the extent to which this change takes place in the different tissues varies within very wide degrees. The tough, unyielding, and almost non-vascular substance of which a tendon is composed scarcely shows the change at all, while the soft and delicate tissue round and between the folds of the synovial sheath is so altered that it can hardly be recognized; but the principle is the same. The change is an essential one, the natural consequence of the injury, and has nothing to do with inflammation. Under certain conditions it may be carried to excess, and then it becomes a source of danger, and may even, by the help of other agencies, become the starting-point of this complication, the cause rather than the consequence. But this ought never to happen, and if the effusion can be restrained within proper limits, and the predisposing causes are not too strong, never does happen. No doubt inflammation follows if a patient, who is on the verge of an attack of gout, by some fall, strains or otherwise injures one of his tendons. It is only natural that it should, and it may come on within an hour after the accident, but it is not fair to put this down entirely to the credit of the injury.

There is another reason for trying to check the effusion as soon as possible. After tendons have been sprained there is always a certain degree of stiffness. This is dependent on

many things, and cannot be helped at first. But the permanence of this stiffness, and its degree, are regulated almost entirely by the extent of the effusion, and by the changes that it undergoes. If it is slight and quickly reabsorbed, leaving only so much as is needed for the repair of the tissues, perfect movement is recovered spontaneously; but when it is excessive, and all the surrounding structures are softened and infiltrated, this can only happen under the most favorable conditions. As a rule, much of it becomes organized; and then all the tissues are made stiff and rigid, and are matted together by adhesions. The minute interstices between them, for the purpose of allowing free and even play of movement, are filled up. Probably during life they contain a semifluid material, so that the structures on either side can easily accommodate each other in their various movements; this quite disappears. In worse cases, the opposite surfaces grow together, and the tendon becomes adherent to its sheath, either in places, here and there, so that fibrous bands pass across from one to the other and limit the range of action, or even all over, so that recovery, so far as movement is concerned, is quite hopeless.

Pressure.—Heat or cold may be tried at first, as already directed in speaking of joints, but by far the most efficacious method is to apply well-graduated pressure from the very commencement. The details, of course, must vary in each case, but when this can be done systematically, not as bandaging ordinarily is, with the whole of the pressure on the bones, nothing succeeds so well. Only there must be a thorough knowledge, not only of the structure and arrangement of the parts, but also of the exact nature of the injury sustained in each case.

Massage.—Massage or kneading is even more useful in the treatment of sprained tendons and muscles than it is in the case of joints. The second day, when the pads and bandages are removed, the limb appears misshapen from the pressure to which the soft tissues have been subjected, and stiff from their confinement. Kneading and working the part thoroughly every day causes this to disappear more rapidly and more effectually than anything else. It must, of course, be done with a definite idea of the purpose in view, and with a knowledge of the structure of the part itself. Further, as the accident is so recent, the ordinary rules must be observed with

even more than usual care. The rubbing at the commencement must be very light, affecting only the skin at first, and then later the deepest structures. Tender spots must be approached very carefully; they need even more attention than the rest, but, unless it is very cautions, manipulation makes them more painful still. Every movement must be commenced at the end of the limb, working gradually toward the trunk. Properly managed, and used at the same time as passive motion, the relief this gives is immense; the pain is exceedingly slight; the swelling disappears more rapidly than it does under any other method, and the chances of after stiffness are materially lessened.

Passive Movement.—There are the same rules with regard to passive motion. It must be employed regularly and systematically every day without fail. The loose tissues round the tendon sheath are softened and thickened; the surface of the synovial sac is rough from the rapidity with which the new cells are formed to line it in place of the old ones; and it is irregular from the swelling of its folds and fringes. Unless movement is kept up from the first this must end in some degree of stiffness. It need not be repeated often at each sitting; once is quite enough, but it must be thorough. Every joint and every tendon near the part that has been injured must be worked at least once a day through its whole range of action. Slight and faint-hearted attempts, apparent movements really taking place at another joint, are useless, and throw discredit on the treatment. They do not prevent the formation of adhesions, or break down those that are already established; they merely pull and strain on the stiffened structures round, and make them painful and tender without setting them free. The adhesions, before they are too firm, are easily separated by definite and well-regulated manipulation without any fear of exciting inflammation. Even after they have become organized it is safer, as has already been shown in speaking of joints, to break them down thoroughly and effectually with one single effort than to keep perpetually straining and worrying them. Weak and ineffectual attempts, carried on hap-hazard, without any definite object in view, do more harm than good. They increase the pain that is left, cause more lymph to be poured out, prevent the absorption of that which is already there, and allow it to accumulate until, as the adhesions grow thicker

and stronger, the prospect of recovery becomes more remote than ever.

In the later stages, when the signs of bruising have nearly disappeared, if the movement of the tendons remains painful and constrained, and particularly if the patient can point out certain spots which are especially tender after use, more energetic treatment is required, just as in cases of imperfect recovery after sprains of other parts. Baths, douching, and shampooing may be tried with success in many instances. Tendons, even when very stiff, nearly always move more freely after long soaking in hot water, and though they may not retain the whole, there is nearly always a certain amount of permanent improvement. Galvanism, too, in these circumstances is sometimes of great assistance in encouraging the circulation and restoring muscular vigor. Stimulating liniments, especially those containing the aromatic oils, are also most useful as adjuncts. They increase the flow of blood through the superficial parts, soothe the pain, and loosen and improve the nutrition of the skin. In this way they are of assistance to other measures which they cannot replace. If there are large and tender muscular masses, which remain stiff and painful, acupuncture often acts with good effect, as described in speaking of sprains of the back; and counter-irritants and small light blisters, often repeated, are of excellent service in many of these cases. If, however, the tender spots are very definitely marked, and if they become more painful and tender regularly after certain movements, these methods are rarely sufficient to secure more than mere temporary relief. Something further is required.

More Permanent Changes, Adhesions, etc.—It may be that there is the residue of an old organized blood clot, outside the sheath altogether, forming a little hard, irregular mass, that is pressed on in certain positions when the tendon is stretched. I have known this it the neighborhood of the knee, in the fibrous expansion given off by the extensor muscle. It was merely a little blood clot, following a blow, lying underneath the fibres; but probably there was a nerve filament near it, for the least contraction of the muscle gave rise to an amount of pain seemingly out of all proportion. I have little doubt that the same thing sometimes occurs in connection with deeper tendons.

In other cases there is an adhesion, or some thickening on the tendon sheath, or there are fringes or loose bodies in the interior continually shifting their position, and keeping up a certain amount of effusion, by the way the sheath is bruised when the tendon moves over it. It is extraordinary what a degree of pain and tenderness may be caused by a body of this kind, whether in a tendon sheath or bursa. Quite recently a patient, a woman of middle age, with rather stout and shapeless limbs, was sent to me, complaining that she had received a blow on the knee about a month before, and that ever since she had suffered such an amount of inconvenience that she could scarcely get about. Walking had become very painful; going upstairs was bad, but coming down she had such a sense of insecurity that she was obliged to cling to the banisters, a statement which I have often heard when there was anything interfering with the action of the extensor of the knee. On examining the joint, it appeared slightly enlarged, but most of the swelling was below the knee-cap on each side of the ligamentum patellæ, caused apparently by the enlargement of the bursa, which exists naturally in this situation, and which is always larger and more prominent in women than it is in men. It was over this that she had received the blow, and here on firm pressure could be felt a large loose body, which, when the muscle was relaxed, slipped easily under the ligament from one side of the joint to the other, causing each time a very peculiar and sickening sensation.

In the same way I have on several occasions been able to trace the development of foreign bodies in the bursa lying in front of the knee-cap. In this situation they give rise to little inconvenience, as a rule, until in kneeling down and reaching forward the weight of the body is brought to bear upon the patella; then there is a sudden stab of acute pain, and within a few hours the bursa becomes filled with fluid. Sometimes there is only one, irregular in size and shape, but often, owing probably to the repetition of the injury before advice is sought, the number is very considerable; or if the first is due to injury, the others may result from the persistent degree of irritation, and even of inflammation, maintained by its presence.

When the pain can be traced definitely to a cause of this kind, there is no alternative. The patient must be placed under an anæsthetic to avoid suffering, and to secure complete

muscular relaxation; the part must be thoroughly examined, and the adhesion, if one is present, broken down, or the foreign body removed. Whatever the cause of the continued tenderness may be, it very rarely happens that it is of a nature to be cured by prolonged rest. In the great majority of instances it is due to this having been too much prolonged already. Most of the crippled joints and tendons that are met with after sprains are due to the fact that passive movement has not been employed sufficiently early or sufficiently thoroughly; and they are only to be cured by the adoption of measures that must be energetic in proportion to the delay.

Ganglions.—Some of these after-consequences, ganglions, for example, require a certain amount of notice, as they either do not occur in connection with sprains of joints, or, when they do, must be treated in a special way. There are two varieties of these; one is a small cyst, originally in connection with the sheath, and probably due in the first place to a protrusion of the sac through a weakened or ruptured part of the wall; the other is a dilatation of the sheath itself. There is no essential difference between these, so far as their origin is concerned; they both frequently originate in strains, though it is possible some may arise from inflammation or in other ways; they contain the same kind of fluid, a clear gelatinous substance, much thicker than natural, and devoid of all lubricating power; and it is often possible to find transition forms between them, sheaths, that is to say, irregularly distended, so that they appear to be sacculated; but the symptoms to which they give rise, and the method of treatment to be adopted, are very different. The former are by far the most common, and occur with especial frequency on the back of the wrist, where they give rise to much annoyance by their unsightly appearance, and by the sensation of weakness that accompanies them. They are met with, however, as well on the foot, on the outside of the knee, just by the head of the fibula, and in other places; indeed, there is hardly a tendon sheath in the body from which they do not sometimes project. As a rule, the inconvenience they cause is not serious, but it is not uncommon to meet with instances in which neuralgic pain of a severe character is a prominent symptom, probably because some small cutaneous nerve happens to be pressed upon by the cyst in certain positions of the limb.

Simple Ganglion.—The ordinary method of treating these is to crush them by direct pressure, and then gradually squeeze the contents into the surrounding tissues, so that they may be absorbed, assisting the process from time to time by friction and kneading, or by the pressure of a leaden plate. Or they may be punctured, and the fluid let out, and if they fill again, injected with iodine, or a small seton passed through them. Or a small tenotomy knife may be introduced on one side of the cyst, and the whole mass divided in two by a horizontal cut; this answers better than the others, as it is impossible for the sac, when it has once been treated in this way, to fill again; but none of these methods are quite satisfactory. They often succeed, it is true; but, even when the cyst does not return, it is very common for a hard irregular mass to be left behind, interfering with the action of the tendons, and causing an unsightly tumor. I have known a swelling of this kind persist unaltered for twenty years in spite of continued attempts by kneading and other measures to get rid of it.

When it is desired to remove them thoroughly and finally, it answers much better to dissect them out. There is no difficulty unless they have been ruptured and squeezed several times before; they separate readily from everything round except the tendon sheath. Generally they are firmly attached to this, and often when the uniting band is severed the tendon may be caught sight of, lying in its groove, and showing that the cyst was in communication with its sheath. If the operation is done carefully, and the hand kept on a splint for a day or two after, the cure is effectual, and the scar can scarcely be seen at the end of a week. If, however, the cyst has been much handled first, particularly if several unsuccessful attempts at squeezing it have been made, it must be left for some time before attempting any such proceding.

Compound Ganglion.—It is more serious when the dilatation involves the sheath itself, especially if it is a large compound one, including many tendons, such as that in the palm of the hand, or if it is in the immediate neighborhood of a joint. Even where there is only a single tendon, and the size of the sheath is not very great, the inconvenience is often considerable; but in these cases the character of the wall rarely undergoes much change, and if they are not cured by blistering or tapping they are certain to yield to subcutaneous incision,

followed by pressure and passive motion. In the larger ones the lining membrane and the contents have, generally speaking, undergone such modifications that it is often impossible to promise more than relief.

Like the others, their origin may sometimes be traced to a single strain, though it is more usual for them to develop as a result of repeated injury. In proportion to their number, communications with joints are certainly more frequent; but this, of course, is mainly regulated by anatomical considerations, and by the condition of the joints themselves. If these are affected by rheumatic gout, or if cysts develop from them for other reasons, it is all the more likely to occur. Sometimes the connection is due, as I have seen myself, to the enormous size of the ganglion; it grows larger and larger until the structures in between are so thinned by absorption that they give way, but more often, as Morrant Baker has shown, the reverse of this happens, diverticula form along tendon sheaths, or through weak parts in the capsule of joints, and appear perhaps some distance off as cysts which closely resemble ganglions.

The fluid in the interior may be identical with that found in the smaller forms, or it may be more liquid and less gelatinous. It develops in a very short space of time; I have found it present and of typical consistence within three weeks of a strain. The wall is usually much altered in character; in one instance it was in a condition almost identical with that met with in joints as a result of strumous inflammation, greatly thickened, that is to say, much too vascular, semi-translucent in appearance, and covered over on its inner surface with numerous little granulations. In other cases it is much tougher and firmer, and projects into the interior in great folds and fringes, which lie between the tendons, and seriously interfere with their action. Occasionally, the sheath is divided into chambers, and very often it contains numbers of minute bodies of the same shape and size as melon seeds. What these are formed of is not absolutely certain in all cases; it seems most probable that, in the majority, they are developed either from the fibrin of extravasated blood, or from lymph that has collected in the sheath, and has been worked continually backward and forward by the movements of the tendons. When they are present in any number the wall is, as a rule, coated

over and roughened with material of the same character, so that probably the latter explanation is correct. They contain no cells or fibres; on the addition of acetic acid they swell up so as to become translucent. All that can be made out is an indistinct concentric marking, as if they were formed of layer after layer of some fibrinous material.

Ganglions such as these must be treated on totally different principles to the smaller ones. Palliative measures are of little use; free subcutaneous division of the wall has been practiced with success in some of the simpler ones, where there are no melon-seed bodies; and in the case of the great palmar one, section of the ligament that divides it in two has been recommended, but I have had no experience of it. Generally speaking, the sac must be laid open freely, the whole of the fluid removed, together with the melon-seed bodies present, any partitions that exist, dividing the interior into chambers, thoroughly broken down, and even in some instances it is necessary to scrape the wall, so as to clear it from the adherent lymph. Then it must be drained so that it does not refill. Naturally this operation is a very serious one. There is great danger of inflammation setting in, and even if it does not, some permanent degree of rigidity, in spite of the early use of passive motion, is always left behind. If it does, the consequences may be disastrous to the very last degree.

Cysts that develop in connection with joints, whether as a result of injury or of rheumatic gout, or of both together, must either be left alone or treated in the same way. In this one would be guided mainly by the age and constitution of the patient, the condition of the joint as regards security and movement, and the size and rapidity of formation of the cyst. I have seen them in connection with the shoulder, ankle, and knees; and no doubt they may occur in other joints as well. Sometimes they caused but little inconvenience; at others they spread so rapidly, and attained such a size, that it was absolutely necessary to drain them. In nearly all there was a great deal of stiffness afterward, but this was due in part to the original disease; one of them suppurated.

CHAPTER XII.

SPRAINS OF THE BACK AND NECK.

Sprains of the back and neck are sufficiently common and important to deserve a certain amount of separate consideration. The structures concerned are exceedingly complicated; there is an immense number of separate joints of various shape and size, and in addition there is the spinal cord running in a canal down nearly the whole of its length, and giving off the nerves which pass out on either side between the bones. Nor do the injuries themselves vary less in character and severity. In some they are exceedingly slight; in others the consequences are as serious as any that occur in surgery. Some, too, have gained a most unenviable notoriety from their connection with railway accidents; for whatever may be the truth as regards many of these cases, whether they are deceptions or not, there can be no question that sometimes very considerable injuries are produced by the way in which the backbone, and the structures in connection with it, are strained and wrenched when the body is thrown violently backward and forward as it is in collisions.

One of the most singular features in connection with these sprains is the way in which the backbone itself, and the muscular and ligamentous structures around it, are overlooked and ignored. Even in the ordinary accidents of every-day life there is a great tendency to lay everything that is serious or lasting to the credit of the spinal cord. In railway cases there is no hesitation at all; if any serious result ensues it must be the consequence of damage this structure has sustained, or of inflammation following it; little or no attention is paid to anything else. Yet it is difficult to see why the other structures should enjoy immunity. The vertebral column may be strained, especially in the cervical and lumbar regions; the ligaments torn or stretched; the nerves bruised or crushed; the smaller

joints between the segments twisted and wrenched; the muscles detached from their bed and torn across, or thrown into such a state of cramp that they become rigid and unable to act with freedom; or the fibrous sheath which contains them and helps to secure the bones laid open and filled with blood. Results, in short, of the most serious description are not uncommon, and often leave lasting evidence of their existence behind, when the spinal cord itself escapes completely.

Injuries of the Spinal Cord.—When it is hurt the symptoms cannot easily be mistaken. There may be insensibility for a time even when the head is not injured. A certain degree of shock is always present, and when this has passed off there is paralysis or loss of power, corresponding in extent and degree to the amount of injury sustained. This may make itself apparent at once, or some time, even hours, may elapse before there is any definite evidence of its presence. Sometimes it is so slight that it can only be detected by the most careful investigation; at others it is so severe as to give rise to the suspicion of fracture or dislocation. Generally speaking, when it is due to bruising, or to what is still more common, effusion of blood into the tissues round the cord so as to compress it, the symptoms begin to diminish at the end of a few days. Recovery may then progress without interruption until it is complete, or it may be arrested at any point, leaving behind it greater or less impairment of power. Sensibility is frequently affected, too, but it rarely suffers in anything like the same degree. If it is lost completely the prognosis must be regarded as exceedingly grave, for it nearly always indicates that at some one point the cord has been crushed and disorganized. Sometimes a certain amount of hyperæsthesia or increased sensitiveness of skin may be detected over a small area immediately above the seat of injury, but the general tenderness all down the spine, which is such a common symptom in sprains of the back, whether they occur in railroad accidents or elsewhere, and the strange sensations, such as crawling, creeping, or tingling, experienced in the limbs, are probably due entirely to other causes. They are certainly met with in cases in which there is no reasonable ground for suspicion that the cord itself has been hurt in any way.

Into this part of the question, however, it is not my intention to enter at present. Injuries of the spinal cord, and the

consequences that may result from them, are matters much too serious to be regarded merely as complications of sprains of the back, and the subject has been already exhaustively treated by Page in his work on "Injuries of the Spine and Spinal Cord." My contention merely is that a very large number of the symptoms which are usually considered as definite proof that the spinal cord has been hurt may be, and in a large proportion of instances probably are, due altogether to the injuries that the other structures in the back must sustain in such accidents.

Injury to the Muscles and Ligaments; Sprains.—S. C., thirty-two years of age, a strong, healthy man of exceptionally good physique, in getting out of a barge slipped and pitched head-foremost into the hold among some bales of goods. The shock was in a measure checked by his hands, or he would almost inevitably have broken his neck. As it was, he lay for some moments unable to extricate himself, with his head doubled under him and his chin driven down upon his chest. He did not lose consciousness; there was no concussion or other injury to his brain; there was no fracture or dislocation anywhere about his spine, though, owing to the severity of the shock he had sustained, he was unable to stand upright, and it was almost certain that his spinal cord had not suffered any very serious hurt, for after he had recovered from the shock he was able to move his arms and legs about freely in all directions. Sensation was not in the least impaired; there was no tingling or feeling of pins and needles; nor was there that peculiar sense of constriction round the body as if a string were tied round it, of which so many patients complain. The stress had fallen almost entirely on the muscles and ligaments at the back of the neck; these, no doubt, were severely strained, and it seems probable from what followed that the nerves running from the spinal cord had suffered in the same way.

The next day the shock had completely passed off. He had slept but little during the night, and he still felt giddy, everything seeming to go round when he attempted to sit upright; but he had recovered his natural color and expression, and the pulse and temperature were perfectly normal. He had completely lost, however, the power of moving his head or neck; the least attempt, especially nodding, brought on severe attacks of pain, shooting up over his head and behind

his ears on each side, so that he sat either with his chin resting on his hand, or with his thumbs behind his ears and his fingers grasping his face. Indeed, without support of some kind he seemed unable to hold his head upright. He complained of his back and neck feeling weak, as if he were going to be paralyzed, mistaking, as Hood has pointed out, the fear of movement due to the pain it causes for actual loss of power. The skin was exceedingly tender to the touch, as it is over every sprained joint, and there was a certain degree of swelling, very ill-defined in outline, over the part that had been most severely strained. What caused him most apprehension, however, was the difficulty that he felt in opening his mouth. He could shut it easily enough, but slight as is the muscular effort required to move it in the opposite direction, it was almost too much for him. The muscles which act from the upper part of the chest, and help to form a fixed point from which the lower jaw can work, were unable to do their fair share. They had not been injured themselves, but the nerves supplying them had been strained in the neck at the moment of the fall, and were unable to carry the necessary stimuli. For the same reason his breathing was very shallow and his speech slow and deliberate.

In a few days this began to pass away; the sense of strength returned, and movement became much more easy; but for a long time a peculiar sensation could be detected in the neck when the head was turned from side to side, as if two roughened surfaces were being rubbed against each other, or some dense fluid, such as extravasated blood, were being squeezed to and fro in the meshes of the cellular tissue. Gradually this, too, disappeared, but in spite of repeated blistering, the stiffness still persisted in the back of his neck. Improvement went on fairly rapidly up to a certain point, but then came to a standstill. Forcible manipulation, however, assisted by thorough kneading, soon effected a cure.

In this case the mischief was well defined, the ultimate recovery, though it was delayed for some time, was complete, and there was no inflammation or other complication. The cord itself was not injured, though just at first there was reasonable ground for suspicion; the whole of the symptoms were due to the damage the muscles and ligaments had sustained, and to the way in which the nerves were stretched.

In all probability, as Page has pointed out, many of the cases of what is sometimes called railway spine may be accounted for in this way. The symptoms, because they are serious and persistent, are referred to the spinal cord, instead of to the structures which surrounded and are especially intended to protect it.

Paralysis is one of these. Where this really exists there can be no question that the spinal cord, or the nerves at their exit from it, have sustained some exceedingly grave hurt. It may be that curious, almost indefinable, effect known, for want of a better term, as shock to the nervous system; or it may be actual bruising and laceration; something of the kind there must be, and in such a case it is necessary to exercise the most extreme precaution in the question of prognosis. But it often happens that, without the least intention of deceiving, patients describe themselves as paralyzed, or unable to perform some particular action, when, as a matter of fact, the attempt is merely prevented by pain, or, what is still more singular, by the belief that they cannot. Hood has pointed out how patients often describe a joint as feeling weak, speaking of it as if it were in need of some mechanical support, when the real cause is the dread of calling into action muscles that are stiffened from disuse or rheumatism. So it is with the spine; after a severe strain there is a certain amount of difficulty about calling the muscles into play, just as there is when they are affected by lumbago, and the patient is naturally very apt to think that he has lost power over them, and is going to be paralyzed. This was the case in the instance that I have quoted above, and similar examples affecting different parts of the body, according to the seat of injury, are of exceedingly common occurrence.

Hyperæsthesia, again, or increased sensitiveness of the skin, is always regarded with great apprehension. In some particular cases, as I have mentioned already, it is true that it is a symptom of injury to the spinal cord; but in the great majority, especially in those in which it extends down the whole of the spinal column, it occurs for exactly the same reason that it does over any sprained ligament, or muscle, and means nothing more.

The crawling sensations, too, that are complained of in various parts of the body, the tingling, and pins and needles,

are still more ambiguous. Often they are due to causes of an entirely different nature, pressure or traction, for example, on some of the nerves, or some alteration in the amount of blood flowing through the part; they cannot, at least in the absence of other evidence, be regarded as proof that the spinal cord has suffered to the exclusion of everything else. Occasionally even more remarkable symptoms are met with. In one case under my own observation, where the patient sustained a very severe strain with some contusion in the lower part of the dorsal region, there were typical attacks of what are known as lightning pains, shooting round the body with great intensity, and then ceasing abruptly; yet there was no evidence at any time that the injury had involved the spinal cord itself.

In short, these symptoms, which are usually regarded as definite proof that the cord has been injured, so far as they prove anything, are rather suggestive of injury to the structures that lie round it and protect it. These must sustain the brunt of the violence in any accident; the cord itself is placed in the position of the greatest possible security, protected as far as it can be from any external hurt, so that in the vast majority of instances it (very fortunately) escapes. From its great importance, and from the disastrous results when it is injured, it has caused everything else to be overlooked and forgotten.

Injury to the Bones.—Of the frequency with which the bones are affected there can be little doubt. Injuries of the back, in the shape of blows or strains, have to account for a very large proportion of cases of disease of the spine; and, probably, if the history of the rest could be obtained, it would be found to be true of most of these. It is difficult, of course, to bring forward direct proof of this; but a certain amount of confirmation may be obtained from the locality in which this affection is most common. A blow may affect any part; but strains, in such a structure as the vertebral column, are always felt most severely where a rigid and a flexible segment are joined together—where, for example, the neck or the lumbar region joins the thorax, which, from the attachment of the ribs and for other reasons, is peculiarly stiff. At any rate, whether this is the explanation or not, it is a fact that disease of the spine is particularly common at these two spots.

Injury to the Smaller Joints.—Sometimes the strain falls

on the smaller joints between the vertebræ, though it must be admitted that it is rarely possible to find any direct evidence of their being hurt. There are so many of them; they lie so close to each other; and the amount of movement possessed by each is so slight that unless the injury is extremely localized its effect is spread too widely to strain any single one. It is not improbable, however, that they suffer more often than is generally suspected; only the injury, owing to the depth at which they lie, and the way in which they are covered in by muscles, is not correctly diagnosed. At least, evidence of past mischief is sometimes found post-mortem, long after all history is forgotten; and suppuration even has been known to occur, and to spread until it made its way into the spinal canal, and involved the cord itself.

Ligaments.—The structures, however, which bear the brunt of strains, are the bands of fibrous tissue, and the muscles on the back and on either side of the vertebral column. With regard to these, the part played by the former is entirely mechanical. Close under the surface there is a broad sheet of extraordinary strength, extending outward over the muscles, binding them down, and protecting them so far as it can from being overstretched. A little deeper it is much more delicate and vascular, forming sheaths for all the separate slips, and uniting them closely to each other. Deeper still it becomes strong again; but here the fibres are short and irregular in direction, running between the prominences with which the bones are covered, and acting the part of ligaments. This fibrous tissue cannot stretch. When the violence is so great that the muscles are overcome, or so sudden that they are caught unawares, it resists as long as it can; then it gives way, rarely at any one single spot; more often here and there, where it is attached to the bones, or becomes continuous with the muscles.

Muscles.—These, on the other hand, are the most active ligaments the back possesses. Not only do they move one bone upon another, but, within certain limits, they are the main agents by which the extent of the movement is regulated. When those limits are passed, and, as a rule, not till then, the purely passive fibrous bands are called into play.

The result of this is that, as a rule, in accidents of this kind, the muscles suffer to a very serious extent. Sometimes they

are overstretched, and lose their power of contracting again; or they are seized with cramp; or they are crushed together and bruised. Sometimes there is a great effusion of blood into their substance, so that they become swollen and painful; or the sheath of fascia which surrounds them is split open to such a degree that they are displaced entirely from their surroundings, and dislocated; or they are even torn in two or wrenched from their attachments.

Dislocation of Muscles.—Many of these injuries occur commonly in sprains of other joints, but one of them, dislocation, is, if not confined to the back, at least very rarely met with elsewhere. It is most common in the neck, for here the movements are very rapid and extensive, while the muscles are especially long and slender. The head is suddenly twisted round to look in some awkward direction; there is a sudden sharp stab of pain, often causing the patient to cry out; something appears to be caught, and the head is held fixed. In a minute or two, when the acute pain has subsided, it can generally be brought nearly straight again: but it requires considerable effort, and it cannot be turned so as to face in the opposite direction, or even kept straight for long. As soon as it is allowed to assume the position of least discomfort, it bends over once more to the affected side. Careful examination in these cases sometimes shows a tender spot on the contracted side, slightly too prominent. If this corresponds in position and direction to some muscular slips, and if, when the part is manipulated, the swelling disappears, and full and painless mobility is instantaneously restored, it can hardly be doubted that the symptoms were due to the dislocation of one of these, which has slipped back into its place again. In some cases an audible snap can be heard by the patient at the moment of reduction; and, in one under my own care, an incautious movement on the part of the patient, before repair was complete, reproduced the displacement.

I have known several instances in which, from the practically instantaneous character of the relief, it is almost certain that this had happened; but I must admit it is much more common for the swelling to disappear gradually and for voluntary power to return by slow degrees. Probably, in these instances, there is no real dislocation; the muscular fibres are either in a state of painful and spasmodic contraction, such as is

common in the leg after unusual exertion, or some of them have been torn and strained, so that movement is painful until the injury is repaired, and the extravasated blood absorbed again.

I have never met with any similar unmistakable dislocation in the loins, though, no doubt, from the description given by Callender, its occurrence is quite possible. The patient, he narrates, was carrying a heavy weight on his shoulders, when he suddenly slipped, and, in spite of all he could do, was swung round by the momentum. The pain for the moment was intense, and though it did not continue his back remained stiff, so that he could not move about with proper freedom. On examining the part there was one very tender spot in the muscles by the side of the spine, where a decided irregularity could be detected; this was diagnosed as a dislocation. The patient was instructed to repeat, so far as he could, the movements he went through as he fell; and while doing this firm pressure was made on the painful spot. The swelling disappeared at once; full power of movement was regained; and the sensation of stiffness completely vanished. The case was completed, and the diagnosis verified by a subsequent repetition of the accident.

Method of Reduction.—In any injury of this description, even if the presence of a dislocation is not certain, it is always worth while to carry out some simple manipulation such as that described above. Whatever may be the reason, whether it relaxes spasm, or whatever it does, it is a fact that almost immediate relief is sometimes gained by this, though the symptoms are not in the least characteristic. In one case under my own care there was no history of an accident at all. The patient was a young man, healthy enough himself, but of rheumatic and gouty parentage. He had been sitting incautiously in a draught when overheated, and got an attack of muscular rheumatism. Curiously enough, however, the pain was limited to one side, and almost to one spot: had he met with an accident, I should at once have suspected the existence of a strain. In spite of the history, however, I determined to try the effect of sudden vigorous contraction, and accordingly made him sit down on a low seat, with his feet firmly pressed against the wall in front, so that the pelvis should be securely fixed. The tender spot was carefully marked, and then it was explained to him that he must stoop forward as low as possible, and at

the word of command suddenly straighten himself up. One arm was placed under his chest to assist him in this, and the thumb of the other hand firmly pressed upon the tender spot. The patient carried his part out loyally, in spite of the pain, and was completely and thoroughly cured at the second attempt. Some pain and stiffness returned in the course of the next day, but determined extension and contraction of the muscles involved, relieved him without further assistance.

It is very important in accidents of this kind to get a perfectly accurate account of the way in which it happened, and the smallest details often prove of great importance. The chief difficulty is to determine whether the seat of injury is one of the smaller joints, or a muscular slip by the side of it. Sometimes a soft and rather indefinite swelling can be made out beneath the skin; more often there is merely a certain amount of local tenderness, with a sensation of stiffness, or of inability to execute some particular movement, amounting in some cases, as has been already mentioned, even to a suspicion of paralysis in the patient's mind. Bruising is rarely seen, owing to the depth at which the injured part lies.

If the situation corresponds fairly well with the position and direction of some slender slip of muscle, the assistance of the patient must be called in, and what is required of him thoroughly explained. There are two chief ways in which the reduction may be effected; sometimes one succeeds, sometimes the other. In the first the patient is placed in an attitude that relaxes the injured part as much as possible, and then, while the hand or finger is firmly pressed upon it, is made to bring it suddenly and vigorously into action. In the second, which is rather the better—for it is very difficult at once, and when suffering pain, to move the back or neck quickly in any given direction at a moment's notice—the body is placed so that the dislocated slip is put upon the stretch, and held in that position by the operator, while the patient endeavors to straighten himself up against the resistance. The muscle suddenly contracts, alters its shape and consistence, and, from the relief that is experienced afterward, must, apparently, slip back again into its bed. Sometimes there is a sharp feeling of pain at the moment, and the preliminary stretching is always disagreeable, but the use of an anæsthetic is, of course, impossible.

Muscular Pain.—The most common trouble, however, after

sprains is something different to this, and is probably closely allied to muscular rheumatism. It may be the result of unusually severe, or of unusually prolonged effort; nothing is felt at the time, or for a few hours; then, generally speaking, at night a peculiar aching sensation begins to make itself felt. The skin is often tender to the touch, especially over the points that correspond to the exit through the fascia of the cutaneous nerves; but there is no heat or redness. The tissues show no sign of bruising; steady pressure, though it is unpleasant at first, gives relief rather than causes pain; and, except as a result of disturbed rest and sleep, there is no fever or constitutional disturbance. There is merely a constant wearing pain, with a sensation of stiffness and want of power, that renders rest for any length of time impossible, and entirely prevents the patient holding himself upright or moving about with freedom.

What may be the actual nature of the change in the tissues is uncertain in many of these cases. In some, no doubt, there is rupture, or straining of the muscular fibres, or there are minute hæmorrhages; but from the practical identity of the symptoms with those of myalgia, due to cold or gout, it seems probable that the cause is to be sought in the changed condition of the circulation, or of the nutrition of the part. During contraction of the muscles a much larger amount of blood flows through them than when they are at rest, and the blood-vessels are very much dilated. It is possible that when this is carried to excess by prolonged overwork it is succeeded by a condition of passive congestion, the vessels being overloaded, and the blood unable to circulate as freely or as rapidly as it should. Then the waste products accumulate and act as sources of irritation, and fresh material to replace that which is exhausted by fatigue is not supplied in sufficient quantity. Probably in those who are young and healthy this is not of material consequence; it merely causes a certain amount of muscular stiffness, which soon subsides when the part is rested and the natural equilibrium once more restored; but if any constitutional taint, such as gout or rheumatism, is present too, it seems to stamp the complaint with its own peculiar character, and makes it tenfold more severe.

The most common situation for this to occur is in the loins, owing to the large masses of muscle situated there, and to the

way in which they are called upon for unusual or sudden exertion in lifting heavy weights; but it may occur anywhere, even in the extremities. Wherever it is, care must be taken not to confound it with other disorders. It is not uncommon for affections, even of such distant parts as the viscera, to be attended by pain in various regions of the spine. To say nothing of examples which must occur to every one, I have known the back-pain of incipient small-pox treated as lumbago, and massage has before now been vigorously applied to a case of stone in the kidney.

General Treatment.—In the milder cases merely local treatment may suffice, but it is so common for an outbreak of some complaint (the existence of which may hitherto not have been suspected) to follow strains, that practically in all general treatment adapted to the particular constitution of each patient is essential. Just as an injury to the foot is often the apparent cause of the first attack of gout, so many of the muscular strains of the back owe at any rate their persistent character to the presence of some similar complication. It is for this reason that careful attention to diet is so necessary; and that such drugs as colchicum, iodide of potash, chloride of ammonia, the carbonates of the alkalies, and others prove so useful. Only it rarely happens that any indication as to which of these internal remedies is likely to prove most beneficial can be derived from the condition of the back itself. This is only to be ascertained by carefully inquiring into the previous history of the patient, and thoroughly investigating the other symptoms that are present. In other words, local measures should be employed to relieve the pain and stiffness, and to restore the condition of the muscles as soon as possible; but it must not be forgotten that the general state of the patient in most instances needs quite as much attention.

Local Measures. Warmth.—Warmth, either applied to the part itself, or generally over the whole surface of the body, is of excellent service in relieving the consequences of strains. The simplest plan is to wring a piece of flannel out of water as hot as can be borne, or to roast it in front of a fire, and press it firmly upon the affected area, renewing it from time to time as it cools. The skin becomes red; more blood circulates through it, and probably a considerable amount is diverted from the deeper parts; the congestion is relieved for the time

being; the waste products are carried away; more nutritive material is supplied, and the stiffness certainly diminishes. Or bags of hot sand, or salt, may be used; they retain the heat considerably longer, and from the way in which they can be fitted into any irregularity of surface, are particularly suited to certain parts of the body. If this is not convenient, the electric brush may be tried, passing it regularly all over the surface of the skin after it has been thoroughly dried first to increase the resistance. It is probable that the benefit derived from this is due almost entirely to the influence it possesses on the blood-vessels, and not in any way to the chemical effects of the current.

Baths.—Hot-water or vapor baths are almost too well known to require mention. Turkish ones also enjoy a great reputation, especially for recent cases, and among those who are accustomed to them. For others, they must be recommended with a certain amount of caution, and the subsequent treatment in any case requires much more attention than it usually receives. At Aix, when the full effect is desired, the patient, after his bath, is quickly dried, wrapped in blankets, and carried in a sedan chair to his hotel. As soon as he reaches his apartment he is lifted into bed, still swathed like a mummy, covered up with additional blankets and a quilt, and left to perspire for a longer or shorter period. After twenty minutes or half an hour he is carefully rubbed down by an attendant who had accompanied him from the bath. Where this is impracticable, the patient should at least be very careful not to hurry away, but to remain two or three hours if necessary, and above all, to make sure that he is properly covered up.

When the complaint has already lasted some time, douche baths may be employed, conjointly with vapor baths. The patient should be seated on a wooden stool, with the feet immersed in warm water so as to avoid chill, and then jets may be directed against his back in any required direction. The size of the jet must be regulated by the amount of pressure, and by the temperature of the water; but it is rarely advisable for it to be more than a quarter of an inch in diameter, and it is always best to begin with warm water, and gradually replace it by cold. The effect is greatly enhanced by massage afterward.

Those who have never tried these baths, or who suffer

either from giddiness and a feeling of fullness in the head, or from a sensation of faintness after their use, may be recommended to take local ones with perfect safety. If the patient is in bed, a cradle may be placed over the body so as to leave a space round him, beneath the bedclothes, and the steam of a kettle introduced by means of properly-arranged tubing, until the desired effect is produced, taking care not to scald the patient's legs. Where he can sit on a chair, it is more convenient to arrange a mackintosh, or, if this is not available, a blanket, round his neck, so as to reach the floor on all sides, and then to place under the seat of a chair a spirit lamp with some boiling water. Both these methods insure copious perspiration within a very few minutes, and possess the great advantage of not affecting the patient's head or interfering with his respiration. Further, there is less risk of catching cold afterward, and aggravating or reproducing the original trouble; if the bath is taken of an evening, the patient can be placed in bed at once, and nearly always can make sure of some hours' refreshing sleep.

At Aix-les-Bains, according to Dr. Stewart, the method is still more highly elaborated. When the patient is sent to have a steam bath (the Berthollet, as it is termed), he is directed to an apartment which contains a curious wooden box, with a round hole in the movable lid. After undressing, he steps into the box, and finds that he is shut in all but the head, the round hole being occupied by his neck. Immediately a valve on the level of the floor is opened, the hot vapor rises about him, and he soon begins to perspire freely. The perspiration running down his brow trickles from his face. Presently he feels the streams flow down his sides and legs, and very speedily a feeling of oppression and debility comes on. After ten or twenty minutes the bath is opened up, the patient carefully dried, and removed to his hotel.

Hot-water baths act in the same way. The beneficial effect they exercise is almost entirely due to their temperature, and proportionate, within limits, to the length of application. The salts that they contain, whether neutral, alkaline, or sulphuretted, are of very little consequence. If they exist in certain degrees of concentration, they stimulate the cutaneous circulation, but that is all. For this reason peat or mud baths are, as a rule, more efficacious. The one feature common to

all bathing establishments which enjoy a high repute is the temperature of the water, and probably the benefit derived from the use of the baths (as distinguished from a sojourn at the place) is due entirely to this.

Friction.—Friction, either with the hand or with a flesh brush, is very grateful in these cases. The direction should be upward, toward the head, and the strokes light and rapid. The effect is, to a certain extent, the same as that of heat; there is a temporary contraction of the vessels near the surface, followed by a more lasting dilatation and more rapid circulation of the blood. It possesses, however, in addition, considerable influence on the nerves of sensation, and it is not improbable that it is felt even more widely than this would imply. At least, it is difficult to explain on other grounds the undoubted power which steady friction along the back seems to possess in allaying some forms of nervous excitement and inducing sleep.

Liniments.—Stimulating liniments, containing camphor, ammonia, or turpentine, may be usefully employed in conjunction with either friction or heat. Sprinkling a few drops of turpentine on the heated flannel before applying it is generally sufficient, or some of the liniment may be rubbed in with the hand. This acts as a mild form of counter-irritant, probably temporarily withdrawing the blood from the deeper parts toward the surface, and where the stiffness and pain have lasted some time this is more effectual than either heat or friction by itself. If the tenderness is limited to one or two spots, and especially if these correspond to the places where the nerves perforate the fascia, blistering fluid, painted on once or twice, according to the thickness of the skin, answers better still.

In rare and exceptional cases more powerful applications, even the actual cautery, may be used. How these act is not clear; they may merely withdraw blood from the deeper parts or they may act in some way through the nervous system; for there is little doubt that certain organs are always in definite nervous relation with certain parts of the surface of the body, and are affected when these are in any way stimulated. However this may be, there is no question that sometimes this agent may be employed in relieving deep-seated pain, especially about the bones, with conspicuous success.

When the skin feels sore and tender after a sprain, the essential or aromatic oils often give very great relief. Many of the quack remedies employed to soothe pain, even the deep-seated pain of acute gout, owe what merit they possess almost entirely to these. A very favorite application in Germany, known as Hoffmann's balsam of life, consists of an alcoholic solution of balsam of Peru and seven of these aromatic oils mingled together. They may be either painted on the skin, and left exposed, or dissolved in spirit in various proportions, and covered over with oiled silk to prevent too rapid evaporation. Menthol is one of the most convenient, and acts especially well when mixed with camphor or croton-chloral, so as to form a thick oily liquid. Probably in this instance, too, the relief is in no small measure due to the effect produced upon the cutaneous nerves.

In certain cases minute quantities of morphia, belladonna, or veratria may be combined with these. It must, however, be remembered that if chloroform is used as a solvent, a considerable amount is absorbed through the skin, particularly if friction is used at the same time, and that in spite of the comparative thickness of the cutaneous covering of the back and the paucity of sebaceous glands. Belladonna plasters, which are strongly recommended by some, not only share with all other plasters the objection of being intolerably dirty, but have the additional disadvantage of sometimes causing an acute attack of eczema. Quite as great benefit may be derived by wearing a belt of flannel or, if this is too irritating, one of silk next the skin.

The hypodermic injection of anodynes, such as morphia, may occasionally be necessary, but it is always as well to postpone this until all other remedies have been exhausted. The very ease with which it gets rid of the pain is its greatest danger. It rarely cures the complaint, though it gives a temporary sensation of comfort, and is only too likely to be required again before many hours are past.

Ironing.—Besides these there are other remedies which are especially suited to deep-seated and large muscular masses, such as exist on either side of the spine in the loins. Ironing has already been alluded to. The patient should lie in bed, rather on his face, with the body supported by pillows in as comfortable a position as possible, and should turn from side

to side as occasion requires. A well-warmed piece of flannel (great stress is laid by some on its being unwashed) is then stretched over the affected part, and the muscles on either side of the backbone thoroughly ironed in all directions with an iron as hot as can conveniently be borne, using considerable pressure at the same time. The best for this purpose are those of rather small size, with the edges and angles well rounded off, so that they may be pressed into all the depressions between the bones without causing pain.

Acupuncture.—Acupuncture, again, though it is rarely employed nowadays, and seems, like bleeding, to have gone out of fashion, is at times very efficient in removing chronic muscular pain. How it acts is not thoroughly explained. Ordinary long darning needles answer very well. They are simply thrust through the skin, deep into the muscles, and withdrawn again after a few minutes. If the plan is successful they leave behind a bright red areola, which varies considerably in size and duration in different cases, and probably is dependent on the condition of the nerves that are stimulated. The pain is exceedingly slight, especially if the thrusts are made firmly and rapidly, and the punctures scarcely bleed.

Galvanism.—Galvanism, too, is very successful in treating muscular stiffness. The skin should be well sponged over first with warm salt and water, so as to avoid irritation as much as possible, and either the labile or the stabile plan adopted. The latter is the best to commence with, and then, after the current has been passing some time, the direction may be reversed once or twice. The electrode applied over the muscle should be of large size (a zinc plate covered over with leather, well moistened, answers as well as anything, as it may be cut or bent to any shape), and the current used of proportionate strength. Then, before leaving off, a smaller electrode may be substituted, and passed over the whole of the surface with a weaker current (if possible in an ascending direction) so as to secure its refreshing action and remove any sensation of fatigue. The sittings should not last longer than five or ten minutes, and it will generally be found that every other day is sufficient, especially if kneading or ironing is used on the alternate ones.

Massage.—Massage, if it is thoroughly carried out, is more successful still. Its action is most refreshing and invigorating.

Under its influence the aching and stiffness disappear, the blood circulates more freely through the muscles, the waste products are carried away, nutrition improves, and strength and voluntary power begin to return at once. It seems to possess the same restorative influence over the deeper structures that friction has upon the skin.

Percussion and kneading are both recommended. The former is the easier, and does not require so much skill or experience; but it only affects superficial parts, and is altogether of more limited application. The ulnar side of the hand may be used, or an instrument which bears a general resemblance to a hammer, with a stem of whalebone to secure elasticity, and a head faced with India-rubber. With this, held rather lightly, the whole of the stiff and painful part of the back is thoroughly percussed, the number of strokes rising to as many as three or four hundred in the minute, until the skin begins to glow.

Kneading is of much greater service, but requires practice before the full benefit can be obtained. The object is to compress and relax alternately the deeper-lying muscles, and to squeeze their contents onward, so as to insure a more rapid flow of blood and plasma through their substance. Consequently the movement must be regular, definite in direction, and well ordered.

A muscle at rest receives an exceedingly small quantity of blood, compared to what flows through it when it is contracting. So long as it is doing no work, the plasma which pours through the walls of the vessels into the interspaces round remains almost stagnant; the fibres are very slow in getting rid of their waste and in receiving a fresh supply. As soon as the muscle begins to act, the vessels dilate, the current of blood is quickened, the plasma is driven on at a much faster rate, and the nutrition improves beyond all measure This is helped to no slight extent by the alteration in the shape of the muscles. These are all incased in a comparatively unyielding fibrous sheath, differing in strength and density in different places. The plasma collects underneath this, filling up all the clefts and spaces left between the fibres. Each time the muscle contracts it compresses some of these, and causes others to dilate, so that it alternately sucks and drives the fluid plasma on. And, as a matter of fact, it is well known that the flow

of plasma, as well as that of blood, through the substance of a muscle, increases immensely as soon as it begins to work.

Massage aims at imitating this. Its object is, by the rolling and kneading of the muscles, to increase the flow of blood and plasma through them, get rid of the accumulated waste, and stimulate nutrition by supplying fresh material in larger quantity. If carried out thoroughly it is almost certain to give relief, but it is not a thing to be undertaken rashly, without previous training, and without some knowledge of anatomy. Massage and rubbing are not synonymous terms.

Supposing the lumbar region to be affected, the patient must be placed upon a couch of convenient height—as already described in speaking of ironing—and well supported from underneath by cushions, so that the muscles of the loin may stand out beneath the skin without being contracted. The operator should stand over him, at a suitable distance, so that his movements are not cramped; and then, with both hands, moving one after the other, knead and squeeze the muscles, first on one side and then on the other, rolling them, as it were, away from the middle line, and pressing them onward and upward toward the head. The whole hand must be used, the fingers, as it were, being insinuated, as far as possible, under and between the groups of muscle, the skin being allowed to glide, to a certain extent, over the structures beneath. Then, if there is any very painful spot left, the muscles may be grasped with the hands and firmly kneaded with the thumbs, moving them round and round in small circles intersecting each other over it so as to knead and squeeze the structures round it from all sides.

The pressure should be gentle at first, and then gradually become firmer and firmer. No liniment or oily substance can be used, as it weakens the grasp of the hands and tends to defeat the object of the manipulation. If it is desired it may be rubbed in afterward. The rate of movement must vary with the thickness and depth of the tissues to be manipulated, and with the amount of pressure used. Within reasonable limits, the slower the better. There is a great tendency on the part of many, who are supposed to practice massage, to use much too much force, and to make all the movements too rapid. Five minutes, as a rule, is sufficient for a sitting, though it is often beneficial to apply an ascending constant

current to the muscles for a minute or two more afterward. It answers better to repeat the manipulation later on in the day than to continue too long at one time. The golden rule is never to fatigue the patient, or to produce the least degree of tenderness or bruising. Those who have not had much experience or a thorough training are very apt to overdo it.

CHAPTER XIII.

INTERNAL DERANGEMENT OF THE KNEE.

The knee joint is occasionally the seat of a peculiar kind of accident, which, for want of a better name, was called internal derangement by Hey, who first described it. It is extremely painful; it occurs during perfect health from most trivial causes; if it happens once it is always liable to occur again; and after a time the joint is very likely to become seriously crippled. Yet, mainly owing to the fact that opportunities of examining the interior of the joint are seldom met with, its pathology is almost as much a matter of discussion as ever it was.

It is undoubtedly connected with two flattened structures in the joint known as the semilunar cartilages. Roughly speaking, they form two circles, lying side by side between the bones. The margin of each is the thickest part; from this they slope off gradually toward the centre, where there is a perforation. The circumference, especially that of the internal one, is attached to the bone more or less firmly all round; but the part corresponding to the centre of the joint, where the two cartilages touch each other, is much the most secure. At this point each of them is interrupted for a short distance, and the four ends so formed are firmly united to the bone beneath. The outer cartilage forms nearly a complete circle, so that its ends lie close together; the inner, on the other hand, barely forms two-thirds of one. This peculiarity of shape, and the presence of several accessory bands, tend to make the inner of the two the more secure. It scarcely moves at all in ordinary actions of the joint, merely, when the weight falls on it, expanding a little in all directions from its centre. The outer one, on the other hand, glides backward and forward freely.

It is generally supposed that in a typical case of internal derangement one or the other of these cartilages slips from its position and is caught between the bones. As a conse-

quence the movement of the joint is abruptly checked; complete extension becomes impossible; the two bones are forcibly wedged apart from each other, and the ligaments that hold them together are stretched and strained. The internal, in spite of its greater security, suffers more often; the external, perhaps from the very way in which it can accommodate itself, nearly always escapes.

Rupture of the Semilunar Cartilages.—Sometimes they are torn completely away from their attachments. Godlee mentions one instance in which the external was found rolled up toward the centre of the joint, having been separated from the bone all around the margin. Annandale has described the anterior end of the internal one, stretched or wrenched away from the bone; and probably they may be injured in other ways as well, torn across, for example, or twisted round in various fashions, or, if the violence is sufficiently severe, forced out from the joint altogether until they project beneath the skin. Then there is, generally speaking, laceration of the lateral or of the internal ligaments of the joint as well, so that the bones are dislocated from each other.

If the joint is the seat of chronic synovitis, or is subject to attacks of rheumatic gout, or if, in younger people, there is that peculiar loosened condition of the ligaments which I have already described, the displacement may be much more complicated. It is not unusual to find in these circumstances that the cartilages may be made to slip backward and forward between the bones by the mere pressure of the finger. It is not fair, however, to regard these as genuine examples of internal derangement. In this, the joint is, to all appearance, perfectly sound and healthy; the violence is exceedingly slight; and the relief is instantaneous. There may be a transient effusion into the cavity of the joint after the displacement has taken place, but clearly there can be no tearing or even severe bruising of any of the internal structures. The greatest injury must fall short of this, or the time required for repair would naturally be much longer.

Displacement Without Rupture.—The best description is given by Knott, of Dublin, who has suffered from it himself on repeated occasions. It first occurred to him when he was a boy, as he was walking quietly along. All of a sudden, without having sustained any wrench or twist of which he was

conscious, he was seized with such agonizing pain on the inner side of the knee joint that he half fell, half sat down, on the ground, sick and faint, with a sensation of utter helplessness. The knee was slightly flexed; he could not move it one way or the other, and voluntary power over it was entirely lost. Instinctively he applied his hands one on either side of the joint, and made as powerful a pressure as he could in the hope of relieving the suffering. This caused the flexion to diminish; when suddenly the pain again became almost intolerable, a clicking sensation was conveyed to his hand and his ear at the same time, and perfect relief came at once. He managed to walk away, and no after trouble of any kind followed.

After that the accident happened to him on many occasions; he noticed that it never occurred during active movement, but only when the muscles were off their guard; and that if the knee-joint was slightly bent, the least force applied so as to turn the toes outward was sufficient to cause it. So long as he walked with the toes turned in the joint felt secure; the reverse of this is the case when the displacement concerns the external of the two cartilages.

From this he is convinced that, at least in his own case, the displacement consists in the posterior part of the internal cartilage gliding forward from its position until it is caught between the bones. This forces them apart, like a wedge, and completely stops the movement of the joint. The muscles round contract at once, and become perfectly rigid, so that voluntary action is out of the question for the time. Afterward, when they are tired out, and the joint fills with fluid, the power of movement returns again; but complete extension is not possible so long as the displacement lasts.

Hey's account is closely similar. He describes the knee as being not unfrequently affected with an internal derangement of its component parts, as a consequence of trifling accidents, and states that the trouble is now and then removed as suddenly as it is produced, by the natural movement of the joint, without surgical assistance of any kind; but that it may remain for weeks or months, and then become a serious misfortune, as it causes a considerable degree of lameness.

"The disorder may happen with or without contusion. In the former the symptoms are equivocal, until the effects of the contusion are removed. When no contusion has happened,

or when the effects of it are removed, the joint, with respect to its shape, appears uninjured. If there is any difference from its usual appearance, it is that the ligament of the patella appears more relaxed than in the sound limb. The leg is readily bent and extended by the hands of the surgeon, and without pain to the patient. At most, the degee of uneasiness caused by this flexion or extension is trifling, but the patient himself cannot freely bend or extend the limb in walking; he is compelled to walk with an invariable and small degree of flexion; yet in sitting down the affected joint will move like the other."

Bonnet, from experiments on the dead subject, confirms Knott's views of what takes place in these cases, and shows clearly that it is produced by twisting the leg outward when the limb is slightly flexed. Certainly there is no laceration or extensive displacement of any internal structure. Sir Astley Cooper wrote of it in much the same terms, stating that it may be produced by striking the inner side of the great toe against any slight projection, when the knee is bent as in walking. I have seen the same thing myself on several occasions, but the most interesting example with which I am acquainted was told me by a medical man of himself. During his student days, while playing at football, he suddenly made a violent kick, missed his aim, and fell down, feeling very sick, with intense pain on the inner side of his knee. He was entirely unable to move the joint, but after a friend had slowly flexed the limb as much as he could, and then rapidly extended it, the pain disappeared all of a sudden, and he could walk as before; only for some days there was a considerable amount of swelling, and a sense of insecurity about the joint. The same thing happened to him on several occasions afterward.

These symptoms agree so closely with those described by Hey, Knott, and Bonnet, that there can be no doubt the actual derangement is the same, though the way in which it is produced is apparently altogether different. I say apparently, because, if the action of the knee joint under these conditions is considered for a moment, the difference completely disappears. When the leg is extended, just as it comes to lie in the same straight line with the thigh, a slight amount of rotation outward takes place at the knee joint, so that the ligaments become tense, and the joint sufficiently secure to bear the

weight of the body in walking. In this particular instance extension was extremely rapid and vigorous; there was no weight resting on the limb to keep the bones in apposition, and, consequently, there was nothing to check the rotation outward. This allowed the posterior margin of the internal cartilage to be carried forward until it was caught and fixed by the spasmodic contraction of the muscles. Voluntary movement at once became out of the question. I have since been told that accidents of a similar character, only not sufficiently severe to cause any actual displacement, are not uncommon at football; there is merely a sickening pain on the inner side of the joint for a few minutes, and in some instances a slight amount of effusion afterward; but the displacement is not carried far enough for the cartilage to be caught and fixed.

Reduction.—The method of reduction has been already mentioned; nothing is easier when once it is understood, especially if the patient is under an anæsthetic. Hey recommended making him sit on a high chair, facing the surgeon, who should grasp the limb firmly, extend it until it was as straight as the circumstances would allow, and then rapidly flex it again. Later surgeons have reversed this proceeding with some advantages, as preliminary extension is much more painful than flexion, and in the second step rapid flexion is somewhat difficult to carry out. Whichever way is adopted, while it is being done firm pressure must be made with the thumb of the disengaged hand over the position of the displaced cartilage. As soon as free movement is restored the limb is carefully padded with cotton wool, and thoroughly bandaged to prevent any accidental redisplacement, and to limit the effusion that is almost certain to follow

After Treatment.—This apparently trivial precaution should never be omitted. The chief danger of this singular accident is its extraordinary liability to occur again and again. If the effusion is not checked at once the capsule and the ligaments yield until the natural tension of the joint is lost, and the displacement becomes easier than ever. When once a commencement has been made these two things act and react continually on each other; each displacement causes a fresh amount of effusion; each time the effusion occurs it makes the displacement more easy. At length it often happens that

the distention becomes chronic and that the joint is seriously disabled, though it must be admitted that when this has happened the displacement does not cause so much pain as it did.

After the effusion has been absorbed it is always advisable to wear a retentive apparatus for some months, especially when indulging in any exertion which, like lawn-tennis, has a particular tendency to produce this derangement. If it has only happened once, an elastic knee-cap, strengthened and padded opposite the internal cartilage, may suffice; but care must be taken with an appliance of this description that more harm than good does not result. It must never be worn at night; and when it is taken off the knee should be thoroughly rubbed and kneaded to restore the circulation through it, or else the tissues waste away and the elastic becomes so comfortable that it is regarded by the patient as indispensable.

If one of the attachments of the cartilage has been torn, so that there is a definite displacement recognized by the projection it forms beneath the skin, on the outer or the inner side of the joint, this is not sufficient. Either a mechanical contrivance must be worn for the purpose of checking irregular movements of the leg when the lateral ligaments are slightly relaxed, or else, as Annandale has done on several occasions, with conspicuous success, the joint must be opened, and the offending cartilage stitched into position.

A very good arrangement for cases of this kind consists of two well-padded metal plates accurately fitted round the knee-cap, one on either side and held together above and below by short straps. These plates are connected together by a steel spring passing horizontally across behind the joint, so that when the splint is in position they press firmly on the unprotected portion of the capsule, where the displacement is most likely to occur. If this does not answer, or if it is thought, from an examination of the case, that the derangement in the case of the internal cartilage is really due rather to outward rotation of the leg while the ligaments are relaxed, the best kind of apparatus is formed on the principle of two lateral bars jointed opposite the knee, and connected together above and below by a circle round the limb, formed partly of metal and partly of leather. An additional strap across the joint above and below the patella is sometimes of service. This is

heavier and more cumbersome, but much more efficient than the former in checking irregular movements of rotation in either direction. Flexion and extension are not in the least impeded, and after the patient has once grown accustomed to it even lawn-tennis is possible in it.

CHAPTER XIV.

CONTRACTION OF THE FINGERS.

It sometimes happens that sprains, instead of running an ordinary course, are liable to be followed by unusual results, due either to some peculiarities of structure in the part itself, or to the presence of an overpowering constitutional taint, or to the influence of both together. One of these, which occurs in the hand, tying down the fingers, and giving rise to serious inconvenience from the way in which it interferes with their movements, is known as Dupuytren's contraction.

Structure.—The whole of the palm of the hand is invested by a sheet of dense fibrous tissue, which forms a sheath round all the muscles, and is closely united to the skin on one surface and the bones on the other. In the centre it is exceedingly strong, stretching over the tendons and retaining them securely in all the movements which the hand executes. It is to this, in great measure, that the palm owes its firm resisting feel. At the sides, where it is continued over the muscles of the thumb and little finger, the thickness is not so great; but where these portions join the central part there are two strong partitions passing deeply toward the back of the hand, and sending off side branches in a direction parallel to the surface between the deeper structures. At the clefts of the fingers the central part breaks up into four divisions, each of which again divides, so as to form bands running down the sides until they become attached to the bones and the sheaths of the tendons. Where the division takes place, and the several portions commence to diverge, another layer, lying deeper than the tendons, comes to reinforce it from below, and just here it is very closely attached to the skin. Sometimes, as a result of strains, this fibrous tissue slowly but almost irresistibly contracts, until the ring and little fingers, and sometimes even the middle one, are rigidly flexed into the palm of

the hand so that no reasonable amount of force can straighten them again.

The first thing to attract attention is the presence of a small hard nodule in the palm of the hand, at a point corresponding to the lowest of the transverse creases into which the skin is thrown, and to the interval between the ring and little fingers. It is not painful unless pressed upon or roughly handled, and does not at first give rise to any inconvenience; there is merely a hardened inelastic spot, where the tissues are bound together so that they do not yield and give way to each other in every movement as they ought. Soon, however, the skin begins to waste and lose its flexibility; the fat disappears, and it becomes tied down to the fascia beneath so firmly that it is practically incorporated with it. Then prolongations may be noticed running from this point upward toward the wrist, and downward to the fingers. The latter are much the stronger, and if the process continues, the ring and little fingers become more and more flexed by the contraction of these bands until they are held down immovably in the palm. One of these two fingers is generally the first; but often both of them suffer, and sometimes the middle and even the index are affected as well. When the bending is complete, the finger catches in everything like a hook, so that it is liable to be pulled back and hurt at any moment, and becomes the source of extreme annoyance from the way in which it interferes with every action, even such apparently trivial matters as shaking hands.

Cause.—Dupuytren was the first to point out the cause of this deformity, and it has ever since been known by his name. He showed that the flexion and subsequent rigidity were due entirely to the contraction of the fascia by the side of the fingers, and that the tendons themselves took no share of any kind in its production. They are and remain perfectly free. It is not, however, quite so simple a process as it appears to be from this; the shortening does not take place merely in one direction. If the part is carefully examined, the first thing that is noticed is a depression of the skin where it is tied down to the tissues beneath. The shrinking is general; the fibrous tissue contracts in all directions, and the change is made more conspicuous still by the absorption of the fat, and the wasting of the soft parts as the blood-vessels become more and more constricted.

It is this which renders the difficulty of effective treatment so great. If the contraction merely took place in one direction, simple division of the shortened band would be sufficient. Unhappily this is rarely the case. The whole of the fibrous tissue of the palm at the affected spot becomes so dense and rigid that such a proceeding scarcely produces any effect. The contraction is as great in depth as it is in length. The fat is absorbed; the muscle wasted; the skin loses it suppleness and flexibility, and the texture is so changed that in advanced cases the whole of the tissue between it and the bones beneath appears to be converted into a dense fibrous mass, which creaks and grates under the knife when an attempt is made to divide it.

Much of the interest that is always expressed about this deformity arises from its supposed connection with gout. It is believed by many that this alone, without injury of any kind, is sufficient to produce it. It is certainly true that it is much more common among men than women, and that many more cases are met with in private practice where gout is frequent than among hospital patients; but it hardly seems probable that this can be the only cause.

If this is the case, it is not a little singular that a Frenchman should have been the first to give a true account of its pathology; and even if the presence of this complaint is admitted as one of the reasons for the obstinate persistence of this contraction, it hardly seems probable that it can be the sole cause of its commencement. In a certain proportion of cases it is impossible to obtain any history of gout, either in the patients themselves, or even in their families; and though it is more commonly met with, it is true, after middle life, it certainly does occur long before. I have seen it as early as one-and-twenty, and one of the worst cases that has ever come under my notice (it was so bad that one of the fingers was amputated) was in a man only four years older.

Urate of soda, too, is rarely found in connection with this, unless there is a general deposit in other parts of the body; and, so far as I know, this form of contraction has never been described in connection with the feet, though it is notorious gout has a special predilection for this region, and there is a layer of fascia in them almost identical in structure and arrangement with that of the palm of the hand. The immediate

cause is either a single, sudden strain, bending the fingers back, or long-continued irritation, such as that produced by the constant pressure of a round-headed stick in the palm of the hand, especially during convalescence from illness. Gout very probably is one of the conditions that predispose to its occurrence, but it is almost certain that it is not the only one.

It is more common among the upper and middle classes (or, perhaps, it would be more correct to say that they more commonly apply for relief) than among laborers, because in these the hands are thoroughly hardened and trained to work of all kinds, and a strain that would cause serious injury in the one is hardly felt by the other. It does, however, occur among out-patients, especially among those who are employed in engineers' shops; I have seen many such cases, and have been assured by the men that quite half of their number are affected more or less, only they do not consider it worth while applying for relief. With regard to this it is significant that, among the class of people who furnish the majority of the out-patients in a general hospital, it is almost as common among women as it is among men.

The comparative weakness of the fingers on the inner side of the hand is sufficient to account for the fact that they are affected almost exclusively. The muscles attached to them are so much weaker that they are unable to stand a strain that is at all sudden or severe, and give way before a force the others can bear with ease.

It is the obstinate and progressive character of this contraction that renders it so serious. When once it has commenced, though it may remain quiescent for long periods, it has on the whole a decided tendency to grow worse and worse. In the earlier stages it may be relieved, or even cured, without great difficulty; in the later ones this is impossible without operation, and sometimes this condition becomes so bad that the patient prefers the permanent and distressing deformity of losing his finger.

Treatment.—Before contraction has made its appearance, when there is only a small hard nodule to be felt beneath the skin, the very simple device of repeatedly working the part with the thumb of the other hand, while the fingers support the back, is often sufficient to arrest its progress, only it must be carried out regularly and systematically. Rotatory motion,

with the affected finger well stretched out, so as to make the contraction tense, is the most useful, changing the direction now and then, and keeping up firm pressure all the while. If this is carefully carried out every day, or better still two or three times a day, and if at the same time further flexion is checked by constantly straightening out the fingers and the palm, pressing them spread out upon a table or other firm object, the tendency can certainly be kept in check for years. Too often, however, this precaution is so simple that it is neglected, and when advice is sought the contraction is already well marked and the skin firmly adherent.

Even then much may be accomplished by the same means, supplemented by the use at night of an appliance devised to exercise a certain amount of continuous traction. In the later stages, and after operations, some contrivance of this description is essential. When the deformity is only slight, I have found an ordinary wooden splint, firmly padded opposite the knuckles, very useful. It must be well fastened by means of straps and buckles to the wrist and the two first fingers; and little caps made of some soft metal, such as thin sheet lead, fitted on to the under surface between the affected joints. Steady continuous traction can then be made on these at night by means of elastic bands; and, if the angle is still more than a right angle, a great amount of improvement can generally be effected in a comparatively short space of time.

Where the flexion is more advanced, or where an operation has been performed, so simple a contrivance is rarely sufficient. It is generally necessary to have an appliance constructed by an instrument-maker. The principle on which they work is essentially the same. There is a broad, well-padded metal plate fitted to the back of the hand, so as to be quite firm, and provided with extension racks lying over the fingers, and bent at an angle to suit the deformity. This is buckled on of an evening, and screwed up until the desired position is obtained.

The difficulty is to graduate the tension with sufficient nicety. On the one hand the continued use of the instrument becomes exceedingly irksome, unless a certain amount of improvement is visible; on the other, there is the pain due to the tension on the fibrous structures of the palm, and the fear of injury to the skin from pressure. It is a rough but fair rule, when no operation has been performed, to straighten out the

fingers each time as far as the patient will allow them; and then to relax again slightly. Progress must be slow, and, if the degree of pain is at all severe, the patient, as a rule, refuses to continue, and remains satisfied with a slight and temporary degree of improvement. Care must be taken as often as the splint is removed, and again before it is applied, to knead the tissues of the palm thoroughly, and to soak the hand in water as hot as can be borne; otherwise a great deal of the benefit that may be derived from the extension is almost certain to be lost.

An immense amount of improvement in the method of operating has been effected in recent years by the ingenuity of various orthopædic surgeons, and especially William Adams. Dupuytren himself merely made a transverse incision through the skin and fascia, at the most resisting point, so that when the finger was straightened out there was a lozenge-shaped wound, the sides of which might in successful cases grow together. This, however, rarely happened; the wound nearly always had to heal by granulating, and the resulting cicatrix possessed, as it always does under these conditions, so great a power of contraction that the deformity was reproduced often in a worse degree. I have seen a finger irretrievably tied down within a month by the cicatrization of a comparatively superficial wound along its under surface, not deep enough to involve either the tendon or its sheath.

This was improved upon first by Goyrand, who, before dividing the contracting band, made a longitudinal incision through the skin so as to improve the chance of primary union. In some cases (those, for example, in which the contraction is deep rather than broad, and does not involve more than one finger) this answers fairly well, especially as the means for securing early union are much better understood at the present day. The skin must be detached first on either side with the greatest care, and the band, besides being completely divided, must be separated as far as possible from its deep connections by incisions parallel to the surface. When so much as this is done, however, it is more satisfactory to isolate the whole of the contracted tissue from its surroundings, and remove it bodily. I have known this done on several occasions with the most excellent results. The most serious objection is that, when the adhesions are spread over any extent of surface, a

great deal of manipulation is required to detach the skin, and, consequently, there is some danger of impairing its power of recovery. If it does perish, the wound that is left is large, though superficial, and there is a great tendency to contraction, so that in cases where the lateral extent is considerable it is, as a rule, advisable to select another method.

For this reason, as soon as the merits of subcutaneous tenotomy became known, other methods were almost entirely superseded. At first the band was divided in one single spot, without much benefit resulting. Then a totally different plan was adopted, minute punctures, as many as may be required, being made wherever the contraction stood out prominently beneath the skin, recollecting that the shrinking is a general one, taking place equally in all directions. The number is not regarded as of any moment. The object is to divide the contraction thoroughly, wherever it resists, and to separate it from the parts beneath.

The palm of the hand is dealt with first, selecting those points where the skin is movable over the subjacent tissue; then each side of the affected fingers by itself. The skin wounds are scarcely visible; there is little or no bleeding, and if they are covered up at once, and firm pressure made with little pads of lint, they ought to be perfectly sound within three days. No attempt at extension must be made until they are.

Where the position of the fingers is such as to allow it, massage is of great assistance, both as a preliminary measure and in the after treatment of the case. It loosens the attachment of the skin, gets rid of the thickened epidermis, so that the wounds close more accurately, and does away, to a great extent, with the necessity of detaching it from its deep connection. But three clear days at least must be allowed to pass before the operation. There is always a certain amount of hyperæmia attendant on kneading and manipulation, and under these conditions this is not advisable.

After the punctures have healed, massage is of even greater service. There is no fear of their being reopened if sufficiently firm pressure is employed. The surface is fixed in this way, so that no tension can fall on them; while the lymph that fills up the interstices of the deep incisions is dispersed, and driven into the absorbents, so that the amount of fresh-formed cicatricial tissue, and the danger of recontraction, are both of them re-

duced to a minimum. It is not uncommon, where the operation has been thoroughly carried out, to find the hard nodules, left behind at first, becoming smaller and smaller, until they either disappear altogether or cease to give rise to any trouble.

Extension, by means of instruments, should be steadily employed, at first all day long, and then, according to the progress made, at night only. The same general rules must be observed as when no operation has been performed, not going too fast, for fear of reopening the punctures and injuring the skin, or too slow, for then the contracting bands will reform and reproduce the deformity. As a rule, it is advisable to make as much progress as possible during the early days, for then the tissues that unite the severed portions are still soft and yielding. If it is to be successful, the whole must be accomplished within three weeks, though the appliance must be worn for some time longer on account of the danger of recontraction.

CHAPTER XV.

MUSCULAR CONTRACTION.

In speaking of the results of sudden twists and sprains, it was mentioned that the muscles and tendons rarely escape altogether, and it was pointed out that sometimes, even when the joints are not concerned, they sustain very serious injuries from being crushed or bruised, and, perhaps, torn in two, in the effort they make to save the joint. This, however, is not all. Though there may be no visible effect at the time, it is not uncommon for changes in the nutrition or the activity of the muscles to make their appearance at a later period, and to become worse and worse as time goes on, until they interfere seriously with the use of the limb, and lead, perhaps, to very grave results.

These may be distinguished from those already described as secondary or remote. There is no fixed time for their occurrence. They may appear within the first few days, or three or four weeks, or even more may pass without any change being noticed, and their variety is almost unlimited. Some are probably the result of inflammation, as when groups of extensor muscles, to the complete exclusion of the rest, waste or atrophy shortly after the injury. Others appear to be dependent on some morbid condition of the nervous system. Many are the direct consequence of the accident, without which they would never have occurred; many more, like those complaints known as hysterical, are merely the local manifestation of a general condition, determined to one particular part by the occurrence of the accident. Some few are still only capable of a conjectural explanation.

Cramp.—In some instances the muscular contraction is of a very simple character, when, for example, after some sudden strain, a particular group, or set, becomes hard and tense, and passes almost at once into a state of spasmodic rigidity. It may last for the instant only, subsiding of itself, and merely

leaving the part stiff and tender for the next day; or if the tension is not relieved it may be kept up until exhaustion compels the fibres to relax. When this occurs, as, for example, in internal derangement of the knee, the joint is said to be locked. So far as the patient himself is concerned it is fixed entirely beyond control. Except by making use of his hands to move it, or by placing it in such a position that the weight of the limb can bear upon it, he has not the least power over it. The spasm does not yield until the cause has been removed by manipulation, or by other suitable measures. It is the direct result of the strain; the muscles and nerves are stretched, and their ends dragged asunder, either by the accident itself or by the displacement of some internal structure. This acts as a stimulus. The contraction is the result, and, until some relief is afforded, voluntary movement is out of the question.

The pain in sudden twists of the loin or neck, when, for instance, the head is quickly turned round for the purpose of looking at something above and behind, is in many cases due to this. The attack is always sudden; the pain very severe, often sufficient to make the patient cry out, and for the moment he feels as if it were impossible to move. Then the head is slowly and cautiously brought round again to the natural position with a perceptible sense of effort. In a few of these there is dislocation or rupture of some of the slender muscular slips that lie by the side of the vertebral column, or bruising of the delicate tissue round and between the smaller joints. Accidents of this kind are well known to occur occasionally, and some instances have been already mentioned. At first the symptoms are very much alike, but there is rarely any difficulty in distinguishing them afterward. The cramp due to a sudden strain disappears much sooner than the others; relief is rapid and often spontaneous; a feeling of soreness may persist, it is true, for days, but the part can be used at once with a fair degree of freedom. In the other cases, owing to the tearing and laceration at the time of the injury, the effects are much more serious. They last a longer time, and it is often necessary for the patient to submit to a long and careful course of treatment before the part is recovered sufficiently to be used again with comfort.

The muscular cramp, which is so common after unusual exertions, among those especially who have a tendency toward

gout, bears a close resemblance to this. It is true that the immediate cause is very trivial, as a rule, and that the contraction rarely involves the whole of the muscle, but the difference almost disappears if due allowance is made for the condition of the tissues at the time. Instead of being fresh and active, they are tired out from overwork; waste products, probably of an acid nature, accumulate in their substance, and there is need of a long period of repose before the blood circulating through them can restore their strength and vigor. In these circumstances a very insignificant stimulus is sufficient to excite contraction. Merely holding the limb in an awkward position will cause it. Some fibres are unduly stretched. Suddenly they swell up, become hard, nodular, and painful; and then, as they tire themselves out, slowly relax and become soft again, leaving the part sore and tender. The muscles, which preserve the most perfect sequence of action so long as they are fresh, become more and more irritable as they are exhausted, so that their fibres are thrown into a state of irregular and spasmodic contraction by stimuli, which, under ordinary conditions, would not have the least influence on them.

The remedy is to straighten out the muscle quietly, but firmly, with as little delay as possible. The patient is generally unable to do it for himself, and then it must be done for him. The head, for example, must be steadily and firmly brought round until it faces the opposite direction. If this is done before complete rigidity sets in the pain and tenderness are much less severe. At the same time great relief may be obtained by kneading and rubbing any hard or contracted mass that can be felt under the skin, the pressure following the course of the fibres until they relax and become soft again. Where the resistance is very obstinate spongiopiline, or flannel wrung out of water as hot as can be borne, may be applied with benefit, and if the tenderness is extreme the rubbing may be continued with an anodyne liniment. As a rule, it is fairly easy to make the contraction subside, but it is as well to caution the patient to be careful afterward about the position in which the part is held. If the muscle is slightly strained again, or kept in a state of tension before recovery is perfect, the cramp is very likely to return at the same spot, and be much more painful.

It does not seem improbable, from what is known of the

use of massage in restoring the energy of overworked muscles and relieving the pain of sudden strains, that great benefit might be derived from it in those cases in which the limbs or particular groups of muscles are liable to be seized with cramp at frequent intervals, without there being any definite cause to account for it, other than the presence of some impurity in the blood. It has a most wonderful influence on the circulation and nutrition; it relieves the exhaustion of fatigue more thoroughly and rapidly than anything else; and it is only reasonable to think that if it were systematically applied the same effects would follow in cases such as these.

Tonic Contraction.—Muscular rigidity after sprains is not, however, always instantaneous or spasmodic; sometimes it comes on quietly and slowly, and persists without any apparent relaxation for an almost indefinite time. It is not painful so long as it is left alone; the joint is merely held rigidly fixed in one position until the tissues become wasted and spoiled for want of use.

In Children.—One variety is often met with in children, and, as Paget has shown, may be regarded as in some degree the result of fear, though it can hardly be due to this alone. The main features in the history are nearly always the same. Some joint has been slightly strained; perhaps it is the elbow, owing to the way in which children are swung round by the hands. A few days after, it is noticed that the arm is held continuously in one position, and then it is found that the muscles on one side of the limb are in a state of rigid contraction, which is maintained so long as the child is awake. Any attempt at straightening it out meets with steady resistance and a peculiar elastic recoil. If the attention is diverted, or, in a still greater degree, if the child is placed under the influence of an anæsthetic, the joint can be moved freely and easily, so that it is clear there are no adhesions or fibrous contractions round. Nothing is out of place; there is no sign of inflammation; the stiffness is purely muscular. It cannot be called voluntary; children cannot, by any effort of will, keep a limb straight and rigid for hours; nor is it due to reflex disturbance starting from the joint, for not only does it involve muscles (*e.g.*, the extensors of the knee) which would never be involved in this way, but the contraction shifts at times rapidly from one set to another, and even from one joint to another.

It is not even necessary that a joint should be involved at all. One of the most obstinate cases I have ever seen was in a boy who had a small ganglion on the back of his wrist; this had been ruptured subcutaneously twice before, but each time it filled again, as they often will. If it was even touched, all the muscles on the back of the forearm quite involuntarily became rigid, so that any attempt at bending the fingers caused severe pain. When the ganglion was removed all the contraction disappeared at once, and did not return.

Now, in some instances, no doubt, this is the unconscious result of fear. The joint has been hurt once, and the child instinctively keeps it stiff to prevent its being hurt again. But this is not all. The child really has not the power of straightening out the muscles, and the longer the case lasts the more marked the inability becomes. Voluntary control is not yet throughly developed. The emotional side of the mind is stronger than the will, and muscular contraction such as this takes place because there is not the power to help it.

The diagnosis seldom presents much difficulty. Self-consciousness in children is not perfect enough to be constantly on its guard; sooner or later something occurs to distract their attention from themselves, the crippled limb is forgotten, and the rigidity vanishes, to return again instantly if the part is touched. In sleep, too, it rarely persists, and it is seldom necessary, even in the most doubtful cases, to resort to the use of anæsthetics. It is quite exceptional in them for the contraction to last long enough to excite any organic change in the muscular substance or the structure of the joint; and the mimicry of inflammation is rarely perfect. Either the position is exceptional, as when the knee is kept straight instead of flexed, or the temperature of the skin is never raised, or something so unusual or incongruous is present, that the suggestion of serious joint disease is put out of court at once.

Treatment.—In many of these cases, where, for instance, a limb has been kept obstinately fixed in one position for some length of time, it is almost impossible to dispense entirely with the use of splints, but it is as well to employ them as little as possible. The object is to strengthen the limb, and to accustom the muscles to act in obedience to the will, not to confine them or to restrict their action. Much more may be effected by quietly making the position of the limb uncomfortable, varying

the method according to the particular circumstances of each case. A mild counter-irritant, for example, may be applied in the angle where one surface presses on another: this is generally sufficient to induce the patient to alter the position of the limb, without anything further, but care must be taken not to blister the skin, which is certain to be soft and tender at this spot.

In other cases it answers better to leave the contraction entirely alone, and to divert the attention successively to different parts of the body. I have seen several instances in which this method of treatment has been followed by conspicuous success; and though the cure may not have been permanent, yet time was gained for the adoption of other measures, and the danger of degenerative changes avoided. Quite recently, two children were brought to me separately on the same day for exactly the same affection. In each a knee had been sprained some time before, and the limb had become stiff and rigid in a position of extreme extension. The least attempt at bending it caused severe pain. There was no heat or redness, or any sign of inflammation, and certainly there was no displacement. Acting on a suggestion of one of the friends, a small blister was placed in each case on the knee of the opposite leg, with the best result; free movement returned within twenty-four hours.

It must not be forgotten, however, that this method of treatment does not aim at permanent success; it merely relieves the symptoms of the moment, and prevents the occurrence of serious after-consequences. It has no influence of any kind on the real cause, which is nearly always some disordered condition of the general health. Until this is set right by measures, which, of course, must vary in each individual case, it is almost hopeless to look forward to any lasting benefit from other plans.

In Adults.—Muscular rigidity of this description is not confined to children. It is nearly as common in young adult life in one sex as well as the other, and is liable to be followed by consequences of a much more serious character. Sometimes it come on suddenly, so that the patient on waking up of a morning is unable to straighten out a limb; sometimes it is so slow and gradual that no one can quite call to mind when it first appeared; there has only been a stiffness, increasing

gradually from day to day, until some accidental circumstance calls attention to it.

Many of these cases resemble, in their chief features, those already described. They are in reality the result of defective voluntary control. Mental power has either never been developed thoroughly or else it is not exercised. It may be that it has remained in the state so characteristic of childhood, or that it has become entirely subordinate to an excessive longing for sympathy. Whatever it is, the cause is not any mischief in the joint; there is no disease or inflammation in the part, though there may be a close resemblance to it. However serious the final result, and it may end in complete loss of use, at any rate at the beginning, the contraction can only be regarded as the local expression of a constitutional weakness, which may show itself in a variety of ways.

Simulation of Joint Disease.—The most striking feature about it is the way in which it can imitate real disease. The resemblance is sometimes extraordinary. In the one case the joint is inflamed and the muscles are tightly contracted, because the least movement of the bones causes intense pain; in the other, the rigidity is merely the act of an emotional or an excited frame of mind, of little importance in itself, and serious only in proportion to the likelihood of its continuance and the secondary changes that follow. Yet the difficulty is sometimes extreme, and it is not lessened by the fact that it is advisable to come to a definite conclusion, and adopt suitable measures as soon as may be. Whatever the cause, if left to itself it is a condition only likely to become steadily worse.

Fortunately, the evidence, if it is properly interpreted, is clear and distinct in the great majority of cases. In some, the first glance is enough. There is a certain order and regularity present in the symptoms when a joint is inflamed; they vary, it is true, according to the joint, but, for each individual one they are fairly constant, and if there is any glaring inconsistency, such as is met with sometimes, the idea of inflammation may be set aside without hesitation. In others, however, the question is not so easily answered, and it is only after repeated examination and the most careful weighing of evidence that such a conclusion can be formed.

The previous history is of very little use. Very often, without the least intention of deceiving, it is entirely mislead-

ing. If at any time, no matter how remote, there was an accident, the symptoms are always dated from it, and if nothing deserving of such a name can be remembered, repeated questioning is sure to suggest it at length. It is only in accordance with human nature that, as a result of continued trying, vague recollection should become a definite picture, the details growing more and more circumstantial each time until the whole thing is clear, and the friends at least are thoroughly convinced. As a matter of fact, it is not unusual for them to be much more certain on such a point as this than the patient himself.

Nor is any great degree of help to be derived from the position of the limb. In cases of emotional contraction in children it is often unusual or inconsistent with the presence of inflammation, as when the knee is kept rigidly extended, but in adults it is commonly identical with that assumed in real disease. So with the locality in which pain is felt. This may correspond exactly, even in such strange features as pain on the inner side of the knee when the hip joint is inflamed.

Sometimes the difficulty is increased by the addition of symptoms that are ordinarily regarded as characteristic of inflammation. The part, for example, may be swollen, and the temperature of the skin raised; there may even be a distinct blush upon the surface; but close examination, even in cases such as these, nearly always reveals their true character. The increase in size, for example, is never very distinct; often it appears to be more considerable than it is, from the wasting of some of the tissues and the passive collection of fluid in others; the rise of temperature (which should always be estimated by a surface thermometer; the hand may easily be deceived) is never above that which is normal in the more protected parts of the body, and the blush, if it were really due to inflammation, would indicate a degree of severity that is certainly not present.

In many instances information may be gained from the length of time that has elapsed since the accident, or at least since the commencement of the symptoms. Muscular rigidity is one of the earliest signs of inflammation, but it never remains the only one. At a very early period others are sure to make their appearance, and as they become more numerous and more marked the diagnosis becomes more easy. Emo-

tional contraction, on the other hand, may last for an indefinite period with no further change than that which has been already described as the result of prolonged inaction.

Unhappily the methods that are so successful in children do not give nearly such certain evidence in the case of adults. In the former it is, comparatively speaking, easy to divert attention from a suspected joint, so that if it is not inflamed the tonic contraction of the muscles quietly disappears and the angle changes. In the latter it is much more difficult. Chance moments of forgetfulness seldom present themselves in them, and the case may be watched for a very considerable time without any change being detected.

Sometimes after all the evidence has been carefully weighed it seems impossible to arrive at a definite conclusion. There is then only one alternative; the patient must be placed under an anæsthetic. This rarely fails. The joint may then be examined without the least pain; the muscles are completely relaxed; the movements are not interfered with; and it becomes possible to ascertain definitely how much of the rigidity is due to spasmodic contraction, and how much to other causes. It often happens that a limb, apparently as rigid as a bar of iron, becomes perfectly flexible as soon as sensibility is lost.

There is, too, as Paget has pointed out, another advantage to be gained by doing this. Valuable information may often be obtained by carefully watching the condition of the muscles while the patient is coming round again. If the rigidity is due to the pain of an inflamed joint they begin to contract and steady the bones long before consciousness has returned; and they do it so gradually and imperceptibly that it is almost impossible to say when the change commences. The rigidity is an instinctive act, independent altogether of the mind or of the higher cerebral centres, and it returns of itself long before these have reassumed their influence. When, on the other hand, no such cause is present, the relaxation continues until some notice is taken of it; then it disappears almost instantaneously, and the muscles become even more rigid than they were before.

At first sight it appears improbable, but it is, nevertheless, true, that the danger of overlooking the presence of inflammation is not nearly so great as that of imagining that it exists when the real cause is the lack of voluntary control and pro-

longed disuse. It is, comparatively speaking, rare for disease, even of such an obscure and deep-seated joint as the hip, to be mistaken for hysteria; the opposite is much more common.

Not Merely Hysteria.—This, however, is not the only reason why these cases of emotional contraction deserve special attention. There is another danger to which they are exposed, scarcely less serious and infinitely more frequent. It is one of the commonest mistakes to regard a case in which it is clear there is no inflammation, merely as hysterical, and to dismiss it summarily as the product of some transient phase of mental emotion. The joint is hysterical, and that is enough; local treatment is not required; indeed, it is considered by many to be actually injurious, as it tends still further to attract the attention of the patient to the part; general measures only are recommended, and the contraction is left entirely to itself.

The result might be anticipated. As I have described already, a part that is kept at rest and never used cannot remain healthy; certain changes inevitably make their appearance; they need not be gross ones, or produce conspicuous alterations; the nutrition of the part suffers, and that is quite enough; the tissues are impoverished and lose the power of working with that complete unconsciousness and absence of effort which is so characteristic and striking a feature of health.

A good example of this may frequently be met with in the case of the arm, because, from the ease with which the shoulder-blade moves upon the chest the shoulder-joint itself can be kept almost at rest for an indefinite period without attracting much attention. The patient is almost always a young girl; there may be a history of injury; more often this cannot be relied on; or there may have been some mental trouble. At any rate, there is sure to have been something that either receives, or wants, the constantly and loudly expressed sympathy of others. The symptoms at first do not seem in any way imperative; there is always a certain amount of pain, which is borne with much resignation; and the movement of the part is constrained and awkward, especially when any attempt is made to raise the hand above the level of the shoulder; but there is nothing apparently serious until the part is examined and compared with the opposite side. Then it is found that all the time the shoulder-joint itself has been kept perfectly quiet, and

that the clumsiness is due to the attempt that has been made by one joint to supply the place of two. The muscles are wasted; the bony prominences stand out unduly; the rounded contour is lost; the arm cannot be lifted from the side; rotating the limb is almost impossible; the soft tissues round the joint have become firm and unyielding, and the patient is unable to raise the hand to the back of the head. The joint is almost rigid; the whole of the movement, or nearly the whole, is apparent only, and is really due to the freedom and ease with which the shoulder-blade glides upon the chest.

A joint in this condition cannot be called hysterical. It is of no consequence whether it originated in hysteria or not. The starting point of the contraction may have been an injury, or it may not; that has nothing to do with it. The joint has been kept at rest and never used; its tissues are starved and wasted; and they are unable to do their work. It is no longer a question of want of voluntary power; the muscles are rigid and the soft tissues round are stiff and unyielding; and until their natural condition is restored by local measures the part cannot work, whether the patient has the power to will it or not. The fault may have been that of the patient originally, but now it has passed entirely out of her control.

This is even more serious than it appears at first sight. A joint that is stiff and painful is always liable to become the seat of hysteria, even when this is not the cause. The patient's health suffers; every attempt at movement causes pain; the existence of the joint is continually being forced upon the mind, it is impossible to forget its condition, and at length it may happen that from this alone, even in those who are, comparatively speaking, strong of will, a condition closely resembling hysteria, if not identical with it, becomes developed. It is for this reason that active, vigorous local treatment, such as I have described already in speaking of the effects of prolonged disuse, is so essential in the treatment of what are called hysterical joints. Until the nutrition is thoroughly restored, and the tissues have recovered their natural power, it is hopeless attempting to effect any improvement by general methods. The two lines of treatment must be carried on together; one without the other is almost useless. It savors of the ridiculous to assure the friends of a patient that if the condition of the joint could only be forgotten recovery would follow at once,

when all the time the tissues are too wasted to do their work, and the least attempt at movement causes pain.

Muscular Contraction from other Causes.—Now and then instances are met with which cannot be explained by any of these causes. Some accident, apparently quite trivial in character, is followed by persistent muscular contraction, without the least trace either of hysteria or inflammation to account for it. One of these that came under my notice recently was in many ways most striking. The patient was a young man, tall, and of good muscular development. While at sea, about a twelvemonth before I saw him, he had strained his knee in getting out of the hatch. His account of the accident was perfectly clear. He had to take a step of great height to obtain a purchase for his foot, and to raise himself up at the same time with his hands; while doing this, pulling on his knee joint with all the strength of which he was capable, from a position of extreme flexion, he felt something snap; there was a moment of intense pain, and he fell back almost helpless. When his knee was examined it was full of fluid, but there was no displacement, and it was not locked. It was thought at the time that it was merely a sprain, and that if it was kept bandaged for a week it would get quite well. In spite of this, however, it was nearly a month before he could rest any weight on it; and even before this he noticed that the muscles which bend the joint were slowly contracting, and that he was gradually losing the power of straightening it out. This grew worse and worse, until at length he was so disabled that he was forced to lay up and consult a surgeon, who placed him under an anæsthetic and straightened the limb by main force. He could walk better after this, but he was still compelled to wear a leather splint to keep the joint extended. As soon as he left it off the knee began to bend itself in a manner entirely beyond control, and, of a morning particularly, it was only after great effort, and with much pain, that he was able to stand upright. To complete his misfortune, he had slipped off the curb-stone and sprained his knee again only a few days before. Since this the loss of control had been worse than ever; it was only with the greatest effort that he could get the limb straight at all; the morning that I saw him he had fainted twice in the attempt; his health was failing, and he was reduced by pain, and by the loss of his appointment, almost to a state of despair.

On removing the splint it was at once apparent that the whole limb was wasted to a certain extent from pressure, but mainly from disuse. There was no discoloration, swelling, or pain; and the only tender spot was the one on the inner side of the knee cap, of which almost all patients complain. The muscles on the front of the thigh had suffered most severely; the flexor ones at the back felt unusually firm and hard, though their bulk, as compared with those of the opposite side, had diminished too. The strangest thing was, that while looking at him, the knee gradually began to bend, until in about three minutes it had reached a right angle without the patient having the least power of preventing it. The movement was perfectly smooth and quiet. There was no cramp; the hamstrings felt somewhat firmer, and that was all. It required the exercise of very considerable strength to bring the limb again into a straight position.

I recommended at first that the limb should be thoroughly encased in a plaster of Paris splint, thinking that the muscles would soon become tired out by the unyielding resistance, assisted by the pressure, but it was of no use; and after being on for a few hours it had to be removed on account of the pain. It did not seem advisable to try the action of local sedatives; the case had lasted too long for them to be of any permanent service, and the patient would not submit again to an anæsthestic, so that it was not possible to manipulate the joint freely. Under these conditions I determined to try the effect of faradization, applied to the weaker muscles on the front of the limb, and met with the most surprising success. During the first application he was able to extend the limb with much greater ease, and after the third he could do it himself, when the current was not being applied. In short, he was completely cured, and returned to his occupation, though the limb, when I saw him again some months later, had not yet regained its normal proportions.

There can be no reasonable doubt that in this case the muscular contraction was the result of the sprain, though unhappily it was impossible to ascertain what was the precise nature of the injury that had befallen him; and no one who saw him, and who witnessed his anxiety to return to duty, would have entertained for a moment the suspicion of hysteria. What may have been the explanation of the unbalanced con-

traction is very doubtful. It seemed as if the nerves supplying the weaker muscles were unable to convey a sufficiently powerful stimulus; that, to use the phrase adopted by Vivian Poore in his Bradshawe lecture, they were blocked, so that the tonic contraction of the other muscles gradually overcame them. The muscular substance itself seemed equally affected on both sides of the limb, so that it could scarcely have been due primarily to this; and there was no reason to believe that the mental determination of the patient was in any way defective. It is possible, it is true, that a condition of irritation may have been induced in one of the nerve twigs supplying the interior of the joint by the changes following the sprain, and that it had travelled, after the fashion of the neuritis described by Erb, to the muscular branches supplying the flexors, stimulating them to increased and disproportionate vigor; but, if this were the case, it is difficult to understand how it was so easily cured. Whichever explanation is correct, it remains an example of muscular contraction, persisting for over a twelvemonth after a sprain, not due to inflammation or hysteria.

CHAPTER XVI.

MUSCULAR WASTING.

Wasting of the muscles is another common consequence of sprains. They lose their tone; the firm elastic sensation when they are pressed on with the finger disappears; they feel soft and pulpy; their strength diminishes and their size decreases until, in extreme cases, they may seem to have disappeared altogether, so plainly and distinctly does the outline of the bones show itself through the skin.

Degeneration from Disuse.—There may be many different reasons for it. Want of exercise, for example, may induce it. A limb kept perfectly at rest and never used, of course, must waste. The structure of the tissues degenerates; they either become infiltrated with fat or replaced by it to such an extent sometimes that the real amount of wasting is concealed. The muscles in some cases appear to retain their normal shape and size; the outline of the limb is nearly perfect, but the vigor and strength are gone, and everything feels soft and inelastic to the touch. In others, when, for instance, the patient is suffering from some disease that drains all his strength away, the wasting is so extreme and the amount of fat deposited so slight that they seem to have vanished altogether, and to leave the bone covered in by nothing but skin.

This change is a general one; it affects all the muscles—indeed, all the tissues of the limb alike; no set or group suffers perceptibly more than the rest; and unless the constitutional affection from which the patient is suffering is such as to preclude it, the prospect of recovery, so far as the muscles are concerned, is exceedingly good, even in extreme cases. There is little or no destruction of the living active portion of the muscle. No matter how diminished in size or strength the residue may be, as soon as it is exercised and the circulation through the limb increased by general treatment (especially a liberal

supply of food), assisted by local measures, such as massage and galvanism, the size and strength return, and in the majority of instances the whole of the former vigor is regained. I have seen this happen on more than one occasion when there literally did not seem a particle of muscle left.

Wasting from Compression.—Wasting of a description in some respects similar to this occurs with great rapidity under the use of constant compression. The worst form is caused by the constriction of an elastic bandage. Sometimes after sprains it is thought advisable to wear one of these. If there has been a great deal of effusion into the cavity of the joint, especially if it has been allowed to remain unabsorbed for any length of time, the capsule becomes softened and stretches until it fails to exert any pressure on its contents. It becomes loose and flaccid, and there is a continual sensation of insecurity and want of strength. The joint itself is actually firm enough, but the patient does not feel that it can be trusted as it was before. What is the reason of this is not certain; it is probably dependent on the nerves that supply the joint, for the same complaint is made of muscles when the sheath of their tendons is distended; and it certainly supplies a very strong argument in favor of removing the surplus fluid from a joint after an injury, by some means or other, with as little delay as possible. However this may be, when the capsule has been left in this condition a patient often feels the greatest comfort from the use of an elastic support, such as an anklet or knee-cap; and, wearing it at first only when he is taking exercise, gradually continues it until it is scarcely left off, even at night. The result may be imagined. In a short time a wasted band is seen all round the limb corresponding accurately to the size of the elastic; the superficial structures are more affected than the deeper ones, owing to the way in which the blood is kept constantly squeezed out of them; and where a muscle lies next the skin, with a broad flat surface of bone beneath, it is wasted to such an extent that its presence can scarcely be recognized, and years may elapse before it recovers. Such appliances may be used when any very unusual degree of exertion is undertaken, for just the same reason that laborers strap a piece of leather tightly round the wrist, but nothing can be worse than wearing them habitually.

These kinds of wasting are not limited to sprains, and their

influence is not confined to the muscles; they are due to general causes, and affect all the tissues of the limb, though, owing to their vascularity and softness of texture, there are differences in degree. Others are the direct consequence of these injuries, and are different in many points. They have no relation to disuse; are not the result of compression; do not involve equally all the muscles of the limb; are not due to fatty degeneration; and what is more serious and more important than all the rest together, unless active measures are taken, sometimes show little or no tendency to recover.

Wasting of Extensor Muscles Only.—One of these affects the extensor muscles almost exclusively, and is remarkable both for the very early period at which it shows itself and the rapidity of its progress. I have been able to detect a distinct change in the tone of a muscle three days after a sprain, and it is common for the diminution in size to be visible at the end of a week. Simple rest, no matter how complete, does not produce the same result in anything like the time. The wasting, too, is often extreme; a few weeks after the receipt of a strain or blow the bony prominences may stand out with great hollows between, so as, for the moment, to give rise to the idea that something is out of joint.

Only the extensor muscles are affected, and the broad ones of coarser texture, such as those covering over the hip or shoulder, suffer most, even when full allowance is made for the peculiarity of their shape. In these two situations in particular the effect is so considerable that it rarely escapes notice, and often is sufficient to attract the attention of the patient even before anything is said about it.

At first the wasting is limited entirely to this particular group; the deltoid, for example, which gives the shoulder its smooth and rounded outline, is the earliest to show the change; then it spreads to those that cover in the shoulder-blade behind. Only after it has lasted some considerable time does it involve the rest, and, as the whole of the limb is affected more or less, then probably as the result of confinement and disuse rather than anything else. The atrophy, too, in these cases is simple, and bears no relation to fatty degeneration. This may set in later, and involve all the muscles of the limb, especially if it is allowed to remain unused for any length of time; but as Valtat, in particular, has shown, both by experi-

ments and clinical observation, the two processes are essentially different.

Many suggestions have been offered in explanation of this, but the most reasonable is that which refers it to influences exerted through the nerves supplying the joint. Some have supposed, as it is common in the shoulder, that it is the result of injury to a nerve which winds round the bone in such a position that it might easily be bruised in falls or strains. But even if this were to happen, it does not follow that the muscles would become wasted in this way. They certainly do not when the ulnar nerve is bruised, and, as a matter of fact, the wasting is not limited to the muscles supplied by this particular branch, but involves all those which straighten out the joint, and which are not in any way connected with it; nor would this explanation be of any service in the case of other joints, such as the hip or knee.

Wasting from Inflammation.—Wasting of this description may be taken as a sure sign that the joint is inflamed, or, more correctly, that it has been, for it continues after the other symptoms have subsided. Its degree and rapidity depend mainly on the cause and severity of the attack. When this is but slight, affecting the vascular tissues of the joint only, or due to such transient local causes as the tension set up by the accumulation of fluid in the interior, it is least marked. If, on the other hand, the deeper textures of the joint, particularly the cartilages, are involved, or if the cause of the inflammation is some condition of acute blood poisoning, it is rapid and extreme. In children it is not common, unless at the commencement of strumous disease. Atrophy of the extensors never fails to appear early in this, though, owing to the slowly progressive nature of the disorder, it is often some time before any well-marked degree is perceptible. In adults it is most often seen in those who, later in life, are subject to attacks of rheumatic gout; and its importance depends in great measure on the warning it gives of this. In itself, it is merely a sign that the joint has been inflamed; it means nothing more, and it gives no indication of the cause. But subcutaneous injuries, such as sprains, are so rarely followed, in young and healthy adults, at any rate, by this complication that when it does occur the existence of some additional reason is always to be suspected. Occasionally it is the

outcome of indiscretion, or of some mistaken method of treatment; sometimes it is due merely to tension, but most frequently when inflammation and wasting follow a simple strain there is a history of gout or rheumatism, or both together. The injury assists the constitutional predisposition by selecting the part to be attacked, and, as it were, antedates the outbreak; in after years, as age advances, it is generally found that assistance of this kind is no longer required, and similar attacks, producing even more severe degrees of wasting, occur independently, without any blow or strain to excite them.

I have known this happen on many occasions. The patient generally gives a history of a sprain or of some unusual or sudden effort a few days before. Very likely nothing is felt at the time; but at a few hours later there is a sense of uneasiness and stiffness about the joint. It is not sufficiently severe to occasion serious anxiety; often there is no complaint about it until the question is asked; but yet it does not get well. Then quite suddenly, ten days or a fortnight after the accident, the condition of the muscles is noticed for the first time. The signs of inflammation may still be visible, or they may have already passed away, leaving the wasting and a certain degree of stiffness; there may be a sense of insecurity and even pain, most severe at night and when the joint is moved, or some distention of the joint cavity; and even in a few instances a perceptible rise of temperature, or there may be other signs of what has been quietly going on; but, as a rule, they are so slight that the discovery is almost accidental, and the diminution in size is thought to have been even more rapid than it really is. In the case of a young officer, who had strained his shoulder while wrestling about a fortnight before, I was solemnly assured that the wasting had come on in the course of a night.

If left to themselves these cases sometimes, but not often, recover without further trouble; the effusion is absorbed; the muscles regain their tone; the stiffness passes off, and full movement returns. If, on the other hand, whatever may have been the original cause, the inflammation does not very soon subside, the changes progress and become exceedingly serious. At first merely the extensor muscles and the lining membrane of the joint are involved; but in a little while the cartilage that covers the ends of the bones and the bones themselves are

affected. Absorption takes place; the length and axis of the limb are altered; symmetry disappears; the movements lose their smoothness and freedom; the range is limited, and the muscles, not only round the affected joint, but also those of the whole limb, become atrophied. Changes of this nature are most often met with after middle life in persons with a strong tendency to rheumatic gout, but they are not confined to this period. They occur as well in young adults, and are sometimes even more acute in them, so that I have known the lower limb lose an inch of its length, and the patient become completely crippled by the pain and wasting round the hip within a twelvemonth of its having been sprained.

Wasting from Overwork.—Atrophy of muscle occasionally makes its appearance after prolonged overwork, and even after a single sudden strain. In the former case there is a great tendency for the wasting to spread from those that are first involved to others; and when this occurs definite and well-known changes are generally found to exist at the same time in the cells of certain regions of the central nervous system. It is certain that there is a connection of some description between overwork and these pathological changes, but it is not easy to say how close this may be. One may be the actual efficient cause of the other, or not improbably some grave constitutional disorder may be the real agent, and the overstrain merely determine the particular group of muscles in which the changes first show themselves. However this may be, there is no question that the exceedingly serious disorder known as progressive muscular atrophy not unfrequently makes its first appearance in muscles that have been subjected to a long and continuous overwork, such as those of the back in "hedgers and ditchers."

Wasting from a Single Strain.—Atrophy due to one single, sudden effort is not so common. I have seen one well-marked case in which the muscles of the upper extremities were involved. The patient, who was a man of good muscular development, had slipped suddenly down some steps while carrying a heavy weight in each hand. In trying to save himself from falling, he made a sudden and vigorous effort with his arms, jerking spasmodically upward the weight that he was carrying. The shoulders and arms were stiff and painful for some time, but nothing remarkable was noticed for about three

weeks or a month, when he became aware of loss of power and of wasting, which, when I saw him, was so extreme as to convey the impression that the whole substance of some of the muscles had disappeared. The affection was nearly symmetrical, that is to say, approximately the same portions of both arms were attacked, and they were those which it is reasonable to imagine would have felt the strain most severely in such an accident. It is possible, it is true, that the wasting was secondary to the severe compression sustained by the nerves, as they run down into the arm over the first rib, between this and the collar-bone, at the moment of the fall. Loss of power and permanent wasting of the muscles are sometimes occasioned in this way, as Dr. Vivian Poore has shown, though as a general rule such momentary compression is not enough. It must be continued for some time to cause so serious a result. But the muscles that were affected in this particular case were too distinct and isolated to admit of such an explanation. They were not torn in any way; there was no evidence of the nerves being injured. There was no loss of sensibility; the pain was not severe; there had simply been one single, sharp contraction; and as a result of this (or at any rate after this) the muscles rapidly wasted and lost their power. Unfortunately, I was unable to watch the case further, and so cannot say what effect galvanism and other treatment would have had, or how it terminated at last. I should think it not improbable that it ultimately ended in the progressive form.

Local Wasting.—Lücke has described the same thing as occurring in the great extensor muscle on the front of the thigh, from the effect of blows or sprains. The wasting may involve the whole of the muscle or only a part, one of the great divisions, for example, of which it is composed, or a smaller portion still. In a case that was recently under my care, a gap could be distinctly felt on the front of the limb, about halfway between the hip joint and the knee. It gave the impression that the muscle had been torn across, and never reunited, though, according to the patient's statement, which was quite clear and definite, it was impossible for it to have been produced in this way. The gap made its appearance slowly and gradually after a strain, nothing being noticed for some days, and it kept steadily increasing in width week by week. Moreover, the electric reaction of the whole muscle was depressed, and

there was a general loss of tone and firmness. Lücke, who has thoroughly gone into the question, has come to the conclusion that there is an actual loss of the contractile substance in these cases similar to that found by Valtat in the atrophy following inflammation of a joint. There is no neuritis or other affection of the nerves, and no extravasation of blood; the wasting may follow either a blow or a strain; and its rapidity is in no way measured by the severity of the injury. There is often a certain amount of pain of a rheumatic character, and not unfrequently a slight amount of effusion into the knee joint; but this is probably passive rather than active, allowed to take place by the relaxation of the capsule of the joint that always follows loss of tone in the extensor muscles. According to the same authority, atrophy of the capsule of the joint with stiffness, and, at a later period, wasting of the other muscles of the leg, are not unlikely to happen, especially in old people.

Muscular Impotence after Strain.—Another peculiar consequence of muscular sprains has been described by Duchenne under the name of functional impotence. It cannot be called atrophy, for, in the earlier stages at least, no gross lesion of any sort can be detected either in the nutrition or in the structure of the muscles. They merely become tired out, and give way with the slightest exertion, so that the joints are no longer properly supported, or the bones sufficiently braced together. Sometimes this is the effect of a single, sudden strain; more often it results from continuing to over-work muscles when they are weak and badly nourished; but it may be produced by blows, and even, it is said, by exposure to cold. At first there is only an indefinite sense of pain and weakness, but after this has lasted for some time the symptoms become more conspicuous. If there is the least exertion the affected muscle is thrown into a state of rigid spasmodic contraction. It does not relax as it ought to in its proper turn, and allow the joint to move smoothly and evenly, but remains tense, contracted, and often in a state of painful cramp. This lasts longer and longer each time until the change becomes permanent; the tendon stands out under the skin like a rigid cord; the substance of the muscles wastes, and is replaced by a kind of fibrous tissue which grows shorter and shorter until the joint is fixed in one position, and a condition is produced almost identical with that which results from prolonged inflammation.

In the Spine. Lateral Curvature.—Functional impotence of this description occasionally occurs in lateral curvature of the spine; and probably is, in some cases, in no slight degree the actual cause, especially when the deformity sets in with great rapidity after a strain. In one instance under my observation, the patient, a boy of fifteen, was swinging by his hands from a horizontal bar, when he was seized with sudden pain running round the abdomen so that he felt sick and faint. After lying down a short time this passed off, and nothing further was noticed until, in a course of a few weeks, his back gave way to such a degree that he was scarcely able to hold himself upright. At no time was there any sign of inflammation or of disease of the bones; there was no bruising or tenderness of any description, so that nothing could have been torn; the joints were uninjured and the movements perfect; only the muscles, from the moment they had been strained, had altogether lost their strength. By a vigorous effort after a prolonged rest, they were able to get the back nearly straight again, but they were quite unable to maintain it; almost at once they began to relax and give way. There was no serious alteration in their structure, for under proper treatment recovery was rapid and complete; they had merely lost their power as the result of one single, but severe strain. Had the case been left to itself, there is little doubt the deformity would have continued to increase, and ultimately would have become permanent.

In the Leg. Flat Foot.—Functional impotence is still more common when the strain, instead of being momentary like this, is kept up for a considerable length of time day after day. The muscles then never have the opportunity of thorough rest and relaxation; they are continuously overtaxed; and degeneration, often permanent in character, is very likely to be the result. This is frequently seen in the common form of flat foot occurring at puberty. Duchenne has shown that of the arches of the foot the long one is maintained almost entirely by the action of certain muscles on the outer side of the leg, the peronæi. The posterior pillar of the arch formed by the heel is almost vertical; the anterior, made up of the bones which form the great toe, is long and slanting. When the weight of the body falls on the crown of the arch, the posterior pillar is fixed by the pressure; the other would slip forward,

and allow the arch of the foot to sink down, if it were not for the muscles that hold it back. After long-continued standing, kept up for many days together, for many hours each day, these muscles, especially in a growing lad, gradually become tired out and yield. Then the tension falls on the ligaments, which, like all such structures when exposed to a continuous strain they were never intended to bear, stretch, and become the seat of acute pain, spreading up either side of the leg. Finally, they give way; the arch of the foot sinks, and the internal border becomes proportionately elongated. If, when this stage is reached, the peronæi muscles are examined, the tendons in which they end are found to stand out like rigid cords. Under the influence of the unceasing strain to which they are unequal, they have passed into a condition of permanent degeneration, probably identical with the contracture that follows inflammation, and now by their shortening form one of the great obstacles in the way of recovery.

I must not be understood to say that all cases of flat foot originate in functional impotence of the peronæi muscles caused by overstrain; but I am quite sure this is the chief element in a very large proportion, and I am able to confirm this by a case of my own, in which the cause of the loss of power was entirely different, but the effect the same. The patient, who was a strong, athletic young man, about a month before I saw him had received a severe blow on the outside of the leg, immediately over the middle of these muscles. No especial attention was paid to it at the time; there was a bruise, and that was all. But in two or three days he noticed that walking, and to a still greater degree standing upright, caused him considerable inconvenience. This grew worse and worse, until, owing to the nature of the trouble from which he was suffering not being properly understood, he was reduced to such a condition that he could scarcely walk six steps at a time. The pain was so intense that he was compelled to stop and lift his foot off the ground. This gave instantaneous relief, but the moment he rested his weight on it again all the old suffering returned. The description he gave was exceedingly clear. At first there was merely a general and ill-defined sense of aching, with a feeling of pins and needles running down the outer side of the leg; then his foot felt tired out, especially in the sole; the aching became more definite, and transformed itself into a

dull, numb pain, most severe behind the outer ankle, but spreading up the limb as high as the knee. The longer he stood the more intense this became and the wider the area it involved, until he was literally compelled to give in, and raise his limb from the ground. Throwing his weight on the outer side of his foot enabled him to walk a few steps further, and he always affirmed that a high-heeled boot enabled him to get about much better than a low one.

Careful examination made it plain that the cause of all his suffering was the injury sustained by this particular muscle. So long as it retained its natural strength, the weight of the body rested on those points of bone which are adapted to receive it, and which are held together by structures proportioned to the strain. The arch of the foot was as perfect as that of the opposite one. But when in a little while the muscle, unequal to its work, commenced to yield, the arch lost its main tie, and the anterior pillar began to slip forward until the whole of the strain fell on the ligaments, stretching them, and causing the peculiar sickening pain that always occurs under these conditions. Fortunately, in this particular case, the nutrition of the muscle was restored before either its structure had undergone a considerable degree of degeneration, or the ligaments had been seriously stretched, so that there was no serious sinking down of the instep. The pain was naturally less with a high-heeled boot, because the weight was then thrown more perpendicularly on the anterior pillar, and the strain on the ligaments was lessened.

Treatment.—The treatment of this complication of sprains requires the greatest care and consideration. It may be dependent on so many causes, and may be indicative of so many different pathological conditions, that of two cases, to all appearance identical, the one may recover easily and readily, the other may be merely a sign of the commencement of some serious disease. The first thing to determine in all cases is whether it is secondary to inflammation or not; if this is present nothing, of course, can be done directly to improve the condition of the muscles, as the majority of the remedies employed for restoring their strength and activity would only tend to aggravate the disorder of the joint. As soon as this has passed away, there is nothing peculiar about the atrophy it leaves, except the ease with which it can be cured in the

earlier stages, and the extreme difficulty it presents in the later after degeneration has set in.

Question of Inflammation.—The best evidence that inflammation has subsided is afforded by the temperature of the skin, as compared with that of the corresponding point on the opposite side of the body. This can only be done satisfactorily by means of a surface thermometer, carefully packed; the hand may be deceived, but this scarcely can. The points chosen must exactly correspond, they must be under the same conditions of exposure, and the rise must be a distinct one. It is not well to attach too much importance to slight alterations if other signs are not present. It seems as if certain people, by directing their attention constantly to one part of the body, possess the power of raising the temperature to a slight extent, probably through dilatation of the blood-vessels, so that from this alone it becomes slightly warmer than its corresponding area. At least, I have on several occasions witnessed phenomena of this kind, for which I could find no other explanation; and the suggestion is quite consistent with what is known of the influence of the mind on other parts, as, for example, the lungs in cases of phthisis. As a rule, if the difference is inconsiderable and variable, it may be taken for granted that inflammation is not present; and that the sooner passive movement and more energetic treatment are adopted, even to the extent of forcibly breaking down adhesions, the better the prospect of recovery.

As I have shown already, in speaking of joints, the danger is that, disregarding the positive evidence of the thermometer, and relying on the fact that movement is painful, it may be imagined that inflammation still continues, and that further rest, with its inevitable consequences, further atrophy, is advisable on that account. The mistake is the more serious, as under such conditions the rigidity is constantly increasing, so that the prospect of recovery, when at length an attempt is made, is even more remote than it was before.

Local.—The local treatment of muscular atrophy is for the most part identical with that which has been described already in speaking of the condition of disused and stiffened joints. Everything is of service that helps to exercise them and to improve the circulation through them. Passive motion, working each of them alternately, first in one direction and then

in the other, sometimes with, sometimes without resistance; stretching them out; massage, in all its forms, especially those which influence most the deeper-lying strata; ironing; bathing and douching with hot and cold water; shampooing; friction with stimulating liniments; and even, were large masses of muscles are concerned, as in the back, acupuncture.

Galvanism.—One other remedy that has scarcely been mentioned yet may be used with the best possible result in many of these cases, and that is galvanism. It is true it is impossible for any one who is not a specialist in the subject to undertake to form an elaborate diagnosis, or to give a definite opinion as to the extent to which degeneration has spread in particular directions. But without attempting this, and even leaving special and unusual cases aside, there is no inconsiderable number of others in which it may be employed with immense benefit under the guidance of simple and ordinary rules. The object is entirely different. It may be impossible, without special education, to give an accurate opinion from the electric phenomena alone as to the condition of the muscles, and the probable course of the degeneration; but this is not what is wanted. The diagnosis has been made already. It is known from other symptoms that the atrophy is the consequence of certain definite causes, such as inflammation, which may or may not have ceased to exert their influence. This is sufficient in all ordinary cases. Galvanism is employed, like massage and other remedies, solely as a means for improving the nutrition of the tissue and restoring the energy to the muscles. For this it is one of the most valuable applications known, and if only there is a fair general knowledge of its use, and the method of its employment, it may be applied in a very large number of cases with the greatest benefit.

In Diagnosis.—It has been thought by some that electricity would be of service in diagnosing the presence of hysteria; that by its means it would be possible in any case to ascertain whether the loss of power is due merely to loss of will or to some actual lesion. If this were so, it would be of the greatest use; the difficulty is a common one and often very considerable. But, unhappily, it is of little or no use for this particular purpose. It does not enable us to discriminate in any definite way between the slighter forms of traumatic or pressure paralysis, and that which is met with in hysterical subjects.

When the atrophy is more advanced, and the degeneration plainly marked, the signs it gives are, it is true, much less equivocal; but the difficulty then has in great measure disappeared, and the diagnosis may be allowed to rest with safety on the other symptoms.

The Induced Current.—Faradization by itself is required only in exceptional cases. Its action, even when applied to the muscles, is mainly on the nerves and their motor ends, and this is rarely needed. I have mentioned one remarkable case in which it proved of value, restoring to full use, after a third or fourth application, a limb that had been almost crippled for over a twelvemonth There was apparently some obstacle to the transmission of stimuli down the nerve into the muscle; the influence of the will was not sufficiently powerful to make its way along it. One set of muscles was, in consequence seriously weakened, and the opposing ones, with their vigor unimpaired, kept the limb constantly contracted. Here faradization apparently opened up the path for the passage of other stimuli, so that full power of movement was regained. Such instances, however, in the absence of hysteria, are not common. When this is the exciting cause, faradization often proves a most effectual remedy; but it is not easy to say in such circumstances how far this is due to moral influences. Apparent paralysis of other muscles, at least where there has been no injury, is not unfrequently cured in this way.

In functional impotence, and in the early stages of the contracture that follows it, mild direct faradization sometimes restores the power more quickly than anything else; but, as a rule, the energetic and protracted action of a strong galvanic current answers better. Or, if a more powerful stimulus is desired, the positive pole may be applied over the muscle, and the current interrupted occasionally, and even reversed. I have had no experience of the simultaneous action of the galvanic and faradic currents, but from what is known of the refreshing influence of the former, and of the power it possesses of increasing the electric excitability of the parts to which it is applied, it seems reasonable to suppose that it would be of material assistance, especially in cases such as these; and by enabling a weaker current to be used would avoid the fatigue and exhaustion which might otherwise result. The alternate action of the two is certainly very successful.

The Constant Current.—For atrophy itself galvanism is more effectual than the interrupted current. It is a mistake to think that the beneficial effect of electrization is to be attributed in any way to the production of muscular contraction. If the nerve centres of the spinal cord are involved, it is impossible to prevent degeneration or wasting. The influence of the continuous current on their nutrition is to be attributed, rather, to its chemical action, to its influence on the circulation, and to the way in which it promotes the absorption of waste products and the regeneration of broken-down elements. As I have already pointed out, it must always be remembered that the nutrition of the tissues is ultimately dependent on the circulation of the plasma outside the walls of the vessels. The blood circulates in these, its fluid constitutents passing out through the walls and permeating the tissues in all directions. The muscular fibres lie embedded, as it were, in a fluid plasma, which requires to be constantly replaced, and its renewal is dependent much more on the activity of the tissue elements themselves than on the mere circulation through the vessels. This, without the other, is of little service. If the tissues are leading an active and energetic life, the circulation of the plasma is carried on at its best; if they remain sluggish and passive, it stagnates round them, the part is badly nourished, and the tissues become sodden and œdematous. In this condition of things regular and systematic employment of galvanism is especially indicated. Whether its influence depends on chemical process or not, it causes the swelling to disappear, quickens the circulation, brings back the color to the skin, and restores the activity of nutrition in a manner equalled by nothing else. Faradization may be used in certain cases, and, as already pointed out, is of great assistance sometimes in conjunction with the constant current; but so far as muscles are concerned in everything beyond the mere production of contraction, the latter is far the most useful.

Generally speaking, it is sufficient that the limb should be galvanized every other day, alternating it with massage for five or ten minutes each time. In certain cases it may be used more frequently, but there is often a tendency, especially on the part of the patients, to over-galvanize the limb. Disappointment must not be felt if it is some time before any decided improvement makes its appearance. The regeneration of

the tissues must be a slow process; absorption and nutrition may be assisted, but they cannot be hurried.

The strength of the current should always be moderate, though it is difficult to lay down any definite rules. It is not possible to be accurate without the aid of delicate and complicated instruments. Specifying the number of cells gives little or no idea; allowance, for example, must be made for difference in the resistance of the skin in different parts of the body. Where it is thin, or where there is a large number of sweat glands, the current passes much more easily than it does elsewhere; and the resistance diminishes with moisture, with pressure, and with the length of time the current is applied, this being due in all probability to the fact that after it has been passing some time the blood circulates more freely through the superficial parts. It should never cause the least suspicion of pain; if actual contraction is desired, each muscle must be stimulated in turn by applying the electrode to its motor point or points, as the case may be; or if the nerve that supplies the muscle is more easily accessible contraction may be produced in this way, but the weakest current that will effect this must always be used. In the case of galvanism the size of the electrodes is a most important consideration. The strength of current passing through the body from a certain number of cells is, other things being equal, dependent on the extent of their surface. Consequently, where there are large masses of muscle, as in the back, and where, accordingly, large plate-like electrodes are employed, a current of proportionate strength should be used. If they are large enough, and kept well moistened, there need be no fear of injuring the skin.

When galvanism is used, for its refreshing action, after faradization or to relieve the sensation of fatigue, the positive pole should be applied to a point more distant from the trunk than the negative in order to obtain as far as possible an ascending current. In other circumstances the cathode is placed directly over the structure it is intended to galvanize, and either held there or slowly moved over it in the direction of the fibres. The latter method is much more stimulating; the current is always varying in intensity, being most vigorous immediately under the electrode, and the energy with which it acts upon the muscles beneath is constantly changing as it moves over their surface; so that in addition to the chemical

influence it possesses it calls out moderate contraction of all the fibres in turn. The rapidity of the movement is as important in determining the amount of muscular contraction as the strength of the current, owing to the suddenness in the variation, when the position of the electrodes is changed.

Even when there is no atrophy galvanism has a very beneficial influence on sprains in their later stages. The action of the muscles, perhaps, is embarrassed; every movement is attended by a sense of stiffness and fatigue; the tissues are rather swollen; the skin feels cold, and the muscles do not respond readily. The injury has been repaired, it is true, and there is no definite alteration in the structure of the part, but it does not perform its function properly, and recovery is not perfect. The circulation requires a stimulus; the conducting power of the nerves is enfeebled; the muscles need educating again, as it were; their contraction is not orderly, as it should be; they do not assist each other, and the movement is not passed on from one to the other as smoothly and evenly as it is in health; the result is a sensation of pain, which prevents freedom of action, and by encouraging the patient to keep the part at rest delays convalescence more and more. Under these conditions the thorough electrization of the whole, using the interrupted and constant currents alternately, often effects a cure in a very short space of time, especially if it is assisted by massage. Nothing restores power and freedom of movement more easily or more quickly. If it fails, and there is no serious disease or inflammation to account for the persistence of the symptoms, the presence of some adhesion, too strong to give way before such mild measures, is to be suspected, and it becomes advisable to examine the joint under an anæsthetic.

MEDICAL JOURNALS

PUBLISHED BY

WILLIAM WOOD & COMPANY

56 & 58 LAFAYETTE PLACE, NEW YORK.

THE MEDICAL RECOR

A WEEKLY JOURNAL OF

Medicine and Surger

$5.00 A YEAR.

WOOD'S

MEDICAL AND SURGI

MONOGRAPHS.

PUBLISHED MONTH

$10.00 A YEAR.

Club Discoun

When several of the Jour

ADDRESS, *the*

Medical Record,
Am. Jour. of Obstetr

Medical Record,
M. & S. Monograph

Am. Jour. of Obstetr
M. & S. Monograph

Medical Record,
Am. Jour. of Obstet
M. & S. Monograp

The Prices, Clubbing Rates
PRINTED. No VERBAL agre

Notice of CHANGES and
Company, and in order to discon
Parties accepting Journals from the Post Office are consider

The Postal Laws especially forbid Postmasters taking ord
Periodicals, at request of Subscribers.

Journal bills when sent are made at full prices. *The Club discount for the current Journal year can be deducted* from the amount of the bill if payment is made according to the terms of subscription.

There are five ways by which money can be sent at our own risk—in a Post Office Money Order, Draft, Check, or an Express Money Order, and when none of these can be procured, in a Registered Letter. All Postmasters are required to register letters whenever requested to do so.

If you send your money in any other way, you must do it at your own risk.

POSTAL NOTES are not a safe way to send money. Any one can get the money on them, and, if lost or stolen, the money cannot be recovered, as no duplicates are issued. Subscribers who send us Postal Notes do so at their own risk.

Biological & Medical Serials

297921

Author

Title Wood's medical and surgical monographs, 2, 1889

DATE.

NAME OF BORROWER.

University of Toront
Library

Biological & Medical Serials

DO NOT
REMOVE
THE
CARD
FROM
THIS
POCKET

Acme Library Card Pocket
Under Pat. "Ref. Index File"
Made by LIBRARY BUREAU